HALEY & ALDRICH

RCRA FACILITY INVESTIGATION WORK PLAN

DELPHI CORPORATION
DELPHI ENERGY & CHASSIS SYSTEMS
PLANT 400
1300 NORTH DORT HIGHWAY

FLINT, MICHIGAN

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

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PLANT 400
1300 NORTH DORT HIGHWAY

FLINT, MICHIGAN

US EPA ID # MID 005 356 647

by

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Cleveland, Ohio

for

Delphi Corporation
Troy, Michigan

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LIST OF ACRONYMS AND ABBREVIATIONS

AOI	Area of Interest
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CCR	Current Conditions Report
CMS	Corrective Measures Study
C&O	Chesapeake and Ohio Railroad
CRP	Community Relations Plan
cm/sec	Centimeter per Second
Delphi	Delphi Corporation
DMP	Data Management Plan
ECT	Environmental Consulting & Technology, Inc.
EI	Environmental Indicators
FSP	Field Sampling Plan
GIS	Geographical Information Systems
GM	General Motors Corporation
Haley & Aldrich	Haley & Aldrich, Inc.
HASP	Health and Safety Plan
HWMU	Hazardous Waste Management Unit
LNAPL	Light Non-Aqueous Phase Liquid
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MW	Monitoring Well
NA	Not Analyzed
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
ND	Not Detected
NOAA	National Oceanographic Atmospheric Administration
NRC	National Response Center
PAH (also PNA)	Polynuclear Aromatic Hydrocarbons
PA/VSI	Preliminary Assessment/Visual Site Inspection
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PMP	Project Management Plan
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SAAs	Satellite Accumulation Areas

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TPH	Total Petroleum Hydrocarbons
U.S. EPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
WWTP	Wastewater Treatment Plant

I. INTRODUCTION

1.1 General

Haley & Aldrich, Inc. (Haley & Aldrich) prepared this RCRA Facility Investigation (RFI) Work Plan under the direction of Delphi Corporation, for the Delphi Energy & Chassis Systems, Plant 400. The United States Environmental Protection Agency (U.S. EPA) ID Number for this facility is #MID 005 356 647. Plant 400 is located at 1300 North Dort Highway in Flint, Michigan (Figures 1 and 2). Plant 400 is also known as the Dort Highway Plant (hereafter referred to as the "Site"). The preparation of the RFI Work Plan is prepared pursuant to the Voluntary Corrective Action (VCA) Agreement between the United States EPA (U.S. EPA) Region V and Delphi, dated 19 September 2002 under the Resource Conservation and Recovery Act (RCRA). The RFI Work Plan was prepared to detail the investigation work necessary to characterize potential releases of hazardous waste or hazardous constituents from the Site.

The Site was originally owned by General Motors Corporation (GM). GM completed its divestiture of Delphi in May 1999, at which time Delphi became the owner of the Site. For convenience, the Site owner in this Work Plan is referred to as Delphi regardless of the time frame discussed.

The Site occupies approximately 68-acres in a predominantly commercial and industrial area. The Site location is shown on Figure 1 and the Site layout is shown on Figure 2.

Historical operations and the potential for a historic release to the environment at each Area of Interest (AOI) have been described in the Current Conditions Report (CCR) (Haley & Aldrich Inc, 2001). Based on the findings of the CCR, 18 AOIs were identified for further investigation. Figure 3 illustrates AOIs to be investigated.

1.2 RFI Goals and Objectives

The overall goal of the RFI is to characterize the nature and extent of any release of hazardous waste and/or hazardous constituents at or from the Site which may pose an unacceptable risk to human health and the environment.

To meet these goals, the objective of the RFI is to collect data of sufficient quality and quantity to support an assessment of potential current and future risks to human health and the environment associated with releases of hazardous waste and/or hazardous constituents.

Specifically, the RFI will:

- Determine whether a release of hazardous waste/constituents to soil, groundwater, surface water, or sediment has occurred at AOIs identified in the CCR as requiring investigation;

- Characterize the source(s) of a release and determine the nature and extent of constituents in environmental media to the extent necessary to protect human health and the environment;
- Characterize actual and potential migration pathways, actual and potential human and environmental receptors, and current and reasonably expected future land and groundwater uses;
- Assess potential risk to human health and the environment associated with releases of hazardous waste/constituents;
- Determine whether interim corrective measures are necessary to control current unacceptable human exposures, or to control migration of contaminated groundwater;
- Provide sufficient data to support a demonstration that current human exposures to contamination above applicable criteria are under control, and that the migration of groundwater contaminated above acceptable levels is stabilized; and
- Determine if final corrective measures are necessary to mitigate all current and future unacceptable risks, if any, to human health and the environment.

The results of the RFI will be used to demonstrate that; (1) all current human exposures to media contaminated with hazardous waste and/or hazardous constituents above risk-based levels are under control, and (2) migration of groundwater contaminated with hazardous waste and/or hazardous constituents above acceptable levels is stabilized within any existing areas of contamination, and any discharge of contaminated groundwater to surface water is either insignificant or shown to be currently acceptable. This demonstration will be documented in Environmental Indicators Reports for Human Health (CA725) and Groundwater (CA750). The results of the RFI will be used to support the selection of final Corrective Measures necessary to protect human health and the environment from all current and future unacceptable risks, if any, due to releases of hazardous waste or hazardous constituents at or from the Site.

1.3 RFI Approach

The RFI Work Plan was prepared to describe the investigation activities intended to evaluate Site conditions and to attain the RFI goals described above. After each phase of the RFI, adequacy of the data will be evaluated to determine whether additional data collection is warranted. When data of sufficient quality and quantity have been collected, the data will be used to support decisions regarding the need for interim or corrective measures as discussed in Section 1.2. The RFI will be undertaken in a phased approach. The first field event (Field Event I) includes the following:

- Surveying existing wells and repairing, rehabilitating, abandoning and/or replacing existing wells to the extent necessary to achieve the RFI goals discussed above.

- Installing monitoring well clusters to characterize regional/general groundwater conditions that will allow appropriate down-gradient well installations during subsequent field events at AOIs where potential groundwater impacts are indicated.
- Collecting hydrogeologic and groundwater quality information from existing and new monitoring wells to evaluate current conditions, verify historic information and to identify data gaps.
- Conducting Geoprobe sampling and analysis of groundwater in the offsite area near the northwest corner of the Site.
- Characterizing soil quality at AOIs that were identified in the CCR as needing further investigation of potentially impacted media.
- Conducting a preliminary assessment of potential human and ecological exposures to environmental media at and surrounding the Site.
- Conducting ground surveying to establish Site location and elevation information.

A second field (Field Event II) event will consist of well installations at individual AOIs where a potential impact to groundwater is indicated from Field Event I soil sampling results. The second event will also include additional soil sampling, as necessary, to achieve RFI goals, as discussed above.

The CCR identified 18 AOIs where further investigation is warranted based on evidence of past release, historic operations, visual observations, file review results, or previous sampling results (if available) (Table 1). Table 2 summarizes the laboratory analyses associated with Field Event I which are intended to characterize the chemical quality of impacted media at these AOIs.

1.4 RFI Work Plan Organization

The RFI Work Plan is organized as follows:

- Section I – Introduction;
- Section II - Site Background;
- Section III - AOI Characterization;
- Section IV - Data Evaluation;
- Section V - Reports;
- Section VI - RFI Work Plan Schedule; and
- Bibliography

In addition, the following plans are included as attachments:

- Project Management Plan (PMP): The PMP presents the technical approach, schedules, and qualifications of personnel performing or directing the implementation of the RFI Work Plan.

- Data Management Plan (DMP): The DMP presents procedures to be employed for managing information, reports, and correspondence associated with the implementation of the RFI Work Plan.
- Health and Safety Plan (HASP): The HASP presents the minimum health and safety requirements to be met by all personnel during the implementation of the RFI Work Plan.
- Community Relations Plan (CRP): The CRP presents the approach which will be utilized for dissemination of information to the public regarding investigative activities, results, and selection of any remedies needed.
- Field Sampling Plan (FSP): The FSP presents procedures for the collection of soil and groundwater samples.
- Quality Assurance Project Plan (QAPP): The QAPP presents the organization, objectives, plan activities and specific quality assurance/quality control (QA/QC) procedures which will be utilized during the implementation of the RFI Work Plan.

1.5 RFI Summary

Table 2 presents a summary of the laboratory analyses currently planned for Field Event I to characterize environmental media as part of the RFI. The analyses required for Field Event II will be based on the outcome of Field Event I. Detailed descriptions of the work to be performed for potentially impacted media at AOIs to be investigated are presented in Section III.

II. SITE BACKGROUND

2.1 Site Location

The Site is located at 1300 North Dort Highway in Genesee County, in Flint, Michigan and covers approximately 68 acres of land (Figure 1). The Site includes Plant 400 and associated buildings, which covers approximately 1,800,000 square feet. Portions of the Site not occupied by buildings are paved or landscaped.

2.2 Surrounding Land Use

The Site is bounded by Dort Highway on the west, by Davison Road on the north, by a Chesapeake and Ohio (C&O) railroad line on the east, and by a Grand Trunk West rail line on the south (Figure 2). Robert T. Longway Boulevard is located along the south side of the Grand Trunk rail line.

Physical features of the area surrounding the Site are shown on Figure 1. Land use north of the Site includes industrial and commercial properties located north of Davison Road. Commercial properties and residential neighborhoods are located along Dort Highway west of the Site. Commercial properties and Delphi's wastewater treatment plant for the Flint East complex are located along Robert T. Longway Boulevard south of the Site. An employee parking lot for both Plant 400 and the Plant 500 Engineering Complex is located east of the Site on the east side of the C&O rail line. West-flowing Gilkey Creek is present approximately 0.2 miles south of the Site.

2.3 Demographics

The Site is located in the City of Flint. According to a demographic release made by the U.S. Census Bureau, the City of Flint covers 33.8 square miles (87.6 square kilometers). The Census data estimated the 1999 population of Flint to be 140,761.

2.4 Climate

The climate in Genesee County is temperate with an average daily temperature in Flint of 47° F (Fahrenheit). The lowest average daily temperature is 15° F in January and the highest average daily temperature is 82° F in July. Extreme temperatures have ranged from -25° F to 101° F. Most precipitation occurs between April and September with an average yearly precipitation of approximately 30.6 inches. The driest periods generally occur in fall and the wettest periods in the spring. The mean, annual wind speed is 11 miles per hour.

2.5 Ecology

An ecological assessment has not been performed at the Site.

2.6 Geologic Setting

According to the Michigan Department of Public Health Water Well and Pump Records for wells installed between 0.5 and 1 mile from the Site, two general geologic units characterize regional hydrologic conditions. The region is underlain by 70 to 120 feet of unconsolidated glacial sediments described as clay and sand. Underlying the glacial sediments, typically at depths of 100 to 120 feet below surface, a limestone or sandstone bedrock unit is reportedly present.

The Quaternary Geology Map of Southern Michigan (Michigan Department of Natural Resources/MDNR, 1982) indicates that the Site overburden is comprised of gray to dark reddish brown lacustrine clay and silt. These unconsolidated strata typically underlie the flat, low-lying areas formerly inundated by the glacial Great Lakes. According to the Centennial Geological Map of the Southern Peninsula of Michigan (MDNR, 1936), the unconsolidated glacial sediments are underlain by bedrock of the Pennsylvanian Saginaw Series. The Series consists of the Upper and Lower Saginaw and Verne Limestone Formations. These are predominantly carbonate sedimentary units. The top of bedrock in the area is reported to be typically 100 to 150 feet below surface grade.

Geologic conditions to a depth of 36 feet below ground surface (bgs) have been characterized during various investigations performed at the Site. These investigations focused on soil and groundwater conditions at several individual AOIs and on hydrogeologic conditions at the Site perimeter. A summary of the conditions observed from previous investigations is presented below.

Previous investigations indicate fill soils are present from ground surface to depths from 7 to 10 feet. Fill soils consist of sand, silt, clay, and gravel with significant variability in grain size over the Site. A saturated sand zone was encountered beneath the fill across most of the Site and ranged from approximately 0.5 to 15 feet.

This upper saturated sand unit is generally underlain by a clay and silt unit. The clay layer appears to be consistent across the Site except for the northwest portion where borings did not encounter the clay. The thickness of the clay is not known for most of the Site as the majority of the wells are screened in the upper saturated sand zone. Two monitoring wells were drilled through the clay and encountered a lower saturated sand unit containing some interbedded clays. The depth of the top of the lower sand was encountered at 20 to 28 feet bgs.

2.7 Hydrogeologic Setting

Regionally, the only hydrogeologic unit of significance is the top of bedrock, which is not used by drinking water wells within one mile of the site (Michigan Department of Public Health). These wells tap the upper 10 to 20 feet of bedrock and are reported to yield between 10 and 50 gpm. There are no records indicating that potable water wells are set in the glacial sediments above the top of bedrock and Site information indicates yields in the overburden are generally insufficient to sustain use in a single residence.

Hydrologic conditions in the shallow overburden at the site have been monitored as part of the various investigations performed by Haley & Aldrich. These investigations have identified two saturated zones in the upper 35 feet of the overburden.

A saturated zone was encountered at depths of 6 to 15 feet below surface in areas where sandy fill soils and the first silty sand unit are present. This hydrostratigraphic unit appears continuous throughout the Site. Monitoring wells were set in the upper saturated zone to assess groundwater quality and hydrologic conditions at the Site. Well screens generally range between 6 and 12 feet below surface. Investigations indicate that the upper saturated sandy zone is relatively thin and yields only limited volumes of groundwater when pumped or bailed. However, the majority of wells set in this zone have contained water sufficient for monitoring and sampling purposes on each monitoring occasion since their installation. The calculated hydraulic conductivities at selected monitoring wells ranged from 6.8×10^{-4} to 6.8×10^{-3} centimeters per second (cm/sec) in the upper sand unit.

A second saturated zone was also identified during previous site investigations. Saturated sediments were encountered at depths of 25 to 30 feet near the Container Storage Area and between 15 and 25 feet below surface near the northwestern and southeastern site perimeter. The saturated strata in these locations generally consisted of silty sands that are overlain by silty, sandy clays. The thickness of this hydrostratigraphic unit is unknown. Where both saturated zones were encountered in the eastern portion of the site, the two zones were separated by 12 to 14 feet of the silty, sandy clay unit. The estimated horizontal hydraulic conductivity of the lower sand unit ranges from 2.6×10^{-4} to 1.1×10^{-2} cm/sec.

During the most recent groundwater perimeter well monitoring event in April 2000, groundwater elevations at the site wells installed to shallow depths ranged between 746 and 754 feet above the National Geodetic Vertical Datum (NGVD). Preliminary investigations suggest upper groundwater flows toward the south-southwest in the northern part of the Site and toward the north-northeast in the southern part of the Site. The April 2000 data included groundwater level measurements from perimeter wells only. Although not determined, it is suspected that the shallow overburden in the interior areas may be influenced by subsurface structures (i.e. basements, underground utilities, etc.). The first field event for the RFI

includes installation of interior and perimeter monitoring well clusters to provide additional information on groundwater flow conditions in the saturated zones.

Groundwater levels were also measured in April 2000 at wells screened in the deeper saturated sand. Elevations ranged between approximately 738 and 741 feet NGVD. Preliminary investigations suggest groundwater flows to the southwest in this zone. The first field event for the RFI includes installation of interior and perimeter monitoring well clusters to provide additional information on groundwater flow conditions in the lower saturated zone.

To date, no wells have been installed in the top of bedrock underlying the Site. Previous investigations at the Delphi Flint East complex have included monitoring of groundwater conditions in overburden at the Plant 500 and Plant 600/700 sites. These investigations and those performed at the Site indicate that hydrogeologic conditions in the overburden at the Flint East complex are laterally variable and do not correlate well over relatively short distances in some areas.

The vertical groundwater flow component between saturated zones has not been fully determined to date. The well installation task presented in later sections of this plan will include planned well cluster installations to evaluate vertical flow components as well as the continuity of the clay unit beneath the Site.

Laboratory analysis of groundwater samples has indicated that groundwater in both saturated zones contains concentrations of volatile organic compounds (VOCs). 1,1-Dichloroethene, trichloroethene, 1,1,1-trichloroethane and vinyl chloride were detected above Michigan Department of Environmental Quality (MDEQ) Generic Cleanup Criteria for potable industrial use. Organic solvents have been detected in the groundwater just beyond the Site boundary in the northwest corner of the Site. In addition, these compounds have been detected in groundwater at the southeast property boundary. In response to this finding, this work plan includes a work scope item to determine the extent of the contamination in groundwater on an expedited basis. Permanent well installations along the northwest and southeast property boundaries are planned to provide additional groundwater quality information.

2.8 Wetlands

Haley & Aldrich did not observe permanent or intermittent wetlands on or adjacent to the Site. Review of U.S. Geological Survey's topographic maps does not indicate the presence of mappable wetlands within one mile of the Site. The closest surface water body is Gilkey Creek, which is located approximately 0.2 miles south of the Site.

2.9 Site and Regional Topography

The topography of the area around the Site is shown on Figure 1. Figure 1 is based on the U.S. Geological Survey's 7.5-minute topographic map of the Flint North quadrangle.

The ground surface elevation at the Site is approximately 760 feet above the NGVD. The Site and surrounding area are generally flat and are developed. Subsurface investigations indicate that fill is approximately 7 to 10 feet thick. This indicates that Site topography is roughly the same as it was prior to development.

2.10 Surface Water Drainage

Based on the regional and Site topography, surface runoff in the vicinity of the Site drains generally to the south toward Gilkey Creek. Gilkey Creek, a perennial stream, flows to the west and joins the Flint River approximately 1.5 miles west of the Site.

According to the National Flood Insurance Program, the Site and surrounding areas are not located in 100- or 500-year flood plains.

2.11 Site History

The Site was first developed in the early-1900s. The first structures were constructed on the northwestern portion of the Site and housed ceramics manufacturing operations. These early operations evolved into manufacturing of automobile components. The manufacturing plant expanded over time and grew to roughly its current configuration by the 1950s.

Automobile components have been manufactured at the Site since early in its history. The automotive products manufactured at the Site have included spark plugs, dashboard components, fuel system components, and filter components. Currently the plant produces spark plugs and automotive fuel pumps.

2.12 Site Features

The Site covers close to 68 acres with about 60 percent occupied by buildings that comprise approximately 1,800,000 square feet of floor space (Figure 2). Portions of the Site not occupied by buildings are paved or landscaped. Railroad spurs occupy portions of the eastern edge of the Site.

Process wastewater from plant operations, plus stormwater collected from portions of the roof and from paved areas, (with the exception of parking areas), are collected and discharged in underground sewer lines to wastewater lift stations located on Site. Storm water from the

southern parking areas of the Site flows to the municipal stormwater system. From the liftstations, wastewater is piped overhead to the Wastewater Treatment Plant (WWTP) located south of Longway Boulevard near the southeast corner of the Site. The WWTP capacity is not sufficient to handle flow from large storm events; therefore, during these events stormwater overflow is directly discharged under permit to Gilkey Creek. Treated wastewater is discharged from the WWTP to the City of Flint municipal sewer system.

Site records indicate one active underground storage tank (UST) is located at the Site and that sixteen former USTs have been removed. According to Site records, four USTs were removed from service but remain in place. These tank areas are discussed in Section III. The current and former USTs have been used for the storage of chemicals, solvents, petroleum products and waste materials.

There are 11 electrical substations with polychlorinated biphenyl (PCB)-containing transformers present at the Site. The transformers were visually inspected during the October 2000 site visit and no evidence of releases were identified.

There are six satellite hazardous-waste accumulation areas (SAAs) located on Site. Once full, containers of hazardous waste from the SAAs are stored for less than 90 days at the Container Storage Area.

2.13 Current Manufacturing Operations

The following are the primary manufacturing processes associated at the Site:

- Metal stamping
- Grinding of metal parts
- Metal machining operations using either water-soluble oil or mineral oil
- Metal finishing operations including:
    - Electroplating, including nickel, zinc, tin, and specialty plating
    - Chemical Conversion Coating
    - Etching
    - Washing
- Zinc Phosphating
- Urethane Gasket Forming
- Ceramic Glazing
- Ceramic Substrate Firing
- Plastic Injection Molding
- Parts Assembly

The plant also conducts a general store operation, shipping and receiving operations, equipment and plant maintenance activities, and chemical treatment of water for recirculating cooling-water systems.

2.14 Permits

A Part A permit application was filed to conduct RCRA-regulated storage of hazardous waste at the Site. Hazardous wastes generated at the Site were stored on the interim-status hazardous waste storage pad between 1981 and 1988. In 1988, the storage area was closed. Plant 400 has operated under RCRA as a hazardous waste generator since 1988. With the interim clean closure of the Container Storage Area, as documented in the MDEQ letter dated 13 February 1997, the facility operates as a generator-only facility.

III. AREAS OF INTEREST TO BE INVESTIGATED

3.1 Introduction

The purpose of this section is to describe the phases of work to be completed during the RFI, provide brief descriptions of each AOI and sampling activities associated with each AOI.

The AOIs that were identified in the CCR for further investigation are summarized on Table 1 and illustrated on Figure 3. AOI-specific chemicals of concern were developed based on the chemical usage that occurred in each area. The general approach to selection of chemicals of concern at each AOI is as follows:

a. Petroleum impacted areas – TCL VOCs, TCL SVOCs, and TAL metals, depending on the area.
b. Hazardous waste areas, container areas and drum storage areas – TCL VOCs, TCL SVOCs and TAL metals.
c. Fire Training Area– TCL VOCs, TCL SVOCs, TCL PCBs, and TAL metals due to the unknown nature of disposal activities.
d. Herbicides, pesticides, dioxins or furans will not be analyzed.

The RFI will be undertaken in iterative phases with the first field event (Field Event I) consisting of the following:

1. Well Rehabilitation, Abandonment, and Replacement of Selected Monitoring Wells
2. Well Installation for Site-wide Groundwater Characterization
3. Groundwater Characterization (AOI-48)
4. Hydrogeologic Testing and Groundwater Characterization
5. AOI Monitoring Well Installations and Groundwater Characterization
6. Soil Sampling and Analysis
7. Preliminary Exposure Assessment
8. Site Survey
9. Soil Background

The second field event (Field Event II) will be undertaken to continue characterizing contaminated media and will include the following:

1. Install monitoring wells at specific AOIs where soil conditions warrant evaluation of groundwater quality.
2. Install monitoring wells to delineate the extent of groundwater contamination above acceptable levels.

3. Sample soils at AOIs where additional information is necessary to support RFI goals.

A more detailed discussion of data evaluation and decision criteria for data collection is provided in Section IV of this plan.

The details of Field Event I are provided below and summarized in Table 2.

3.2 Field Event I

3.2.1 Task 1: Well Rehabilitation, Abandonment and Replacement of Selected Monitoring Wells

A monitoring well survey was performed prior to Corrective Action to locate existing monitoring wells at the Site, determine if they are in a useable condition and, if not, determine rehabilitation/abandonment options. Based on the results of the survey and other considerations such as well location, well depth, etc., Haley & Aldrich Inc. has selected a subset of the existing well network to be used as part of the RFI. The wells will be rehabilitated, as necessary, by replacing surface seals, installing locking caps and conducting well development activities to remove sediment accumulations in the wells. If these wells cannot be adequately rehabilitated, they will be abandoned and replaced according to the procedures provided in the FSP. Table 3 lists existing monitoring wells that will be utilized during the RFI. The locations of these wells are shown on Figure 4.

3.2.2 Task 2: Well Installation for Site-wide Groundwater Characterization

Due to the size of the Site and the lack of existing Site-wide groundwater information, investigation of groundwater conditions on a Site-wide basis is warranted. This task will consist of the installation of well clusters along the perimeter of the Site and the interior of the building as shown on Figure 5. The data gathered during, and subsequent to well installation will be used to develop an understanding of groundwater flow conditions and to determine vertical gradients. The groundwater data will also confirm appropriate locations for well installations at individual AOIs.

Several of the well cluster installations are also intended to confirm previous Geoprobe groundwater sampling results in the northwest and southeast property boundaries of the Site (Figures 6 and 7).

As discussed previously, the thickness of the lower sand is currently unknown at the Site. The drilling effort associated with this task will include determining the

thickness of the lower sand. Due to the unknown nature of contaminant distribution at the Site, the drilling will include casing off the upper sand in source areas (when clay layer is present) prior to drilling into the lower sand to prevent the potential vertical migration of contaminants during the drilling process.

Groundwater monitoring wells will be installed during this field event at the locations shown in Figure 5. The rationale for their selection is as follows:

- MW-4601D – This well will be clustered with existing well MW-4601 and the two wells will be used to characterize groundwater flow conditions in and between the upper and lower sand units in the northeastern section of the Site.
- MW-4604D – This well will be clustered with existing well MW-4604 and the two wells will be used to characterize groundwater flow conditions in the lower sand unit, determine the thickness of the lower sand unit and the vertical contaminant distribution in the northwestern section of the Site.
- MW-4605D – This well will be clustered with existing well MW-4605 and the two wells will be used to characterize groundwater flow conditions in the lower sand unit, determine the thickness of the lower sand unit and the vertical contaminant distribution in the northwestern section of the Site.
- MW-4610S and MW-4610D – These wells will be clustered with MW-4610 and the three wells will be used to characterize groundwater flow conditions in and between the upper and lower sand units, determine the thickness of the lower sand unit and the vertical contaminant distribution in the southeastern section of the Site.
- MW-4615S – This well will be clustered with existing well MW-4615 and the two wells will be used to characterize groundwater flow conditions in and between the upper and lower sand units in the eastern section of the Site. In addition, the wells will provide information regarding groundwater quality along the southeast property boundary of the Site.
- MW-4623S and MW-4623D – These new wells will be clustered and they will be used to characterize groundwater flow conditions in the lower sand unit, determine the thickness of the lower sand unit and the vertical contaminant distribution in the northwestern section of the Site.
- MW-4620S and MW-4620D, MW-4621S and MW-4621D, MW-4622S and MW-4622D (all new) – These wells will be clustered and they will be used to characterize groundwater flow conditions in and between the upper and lower sand units in the interior portion of the Site.

Shallow wells will be installed into the upper sand and the deep wells will be installed into the upper portion of the lower sand. Monitoring wells will consist of a 10-foot, 2-inch diameter PVC well screen (No. 10 slot size), and a 2-inch diameter PVC riser. Details of well installation procedures are provided in the FSP. As stated previously, due to the unknown nature of contaminant distribution at the Site, the drilling will include casing off the upper sand in source areas (when clay layer is present) prior to drilling into the lower sand to prevent the potential vertical migration of contaminants during the drilling process.

Up to three soil samples will be collected from each boring to evaluate soil quality at each cluster location. One sample will be collected from 0 to 2 feet bgs to evaluate direct contact exposures. Another sample will be collected from 8 to 10 feet to evaluate construction worker exposures. A third sample will be collected directly above the water table. A fourth sample may be collected between the samples if contamination is indicated by field screening of samples with a portable photoionization detector (PID) and/or visual observation. The number of samples may vary depending on the depth to groundwater. The samples will be analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, and TAL metals.

3.2.3 Task 3: Groundwater Characterization (AOI-48)

As previously described in the CCR, contaminants have been detected on and off-Site along the northwest corner of the Site. The location of previous Geoprobe® groundwater grab samples are illustrated in Figure 6 and the data is presented in the CCR. The southeast Site boundary has also been investigated for contaminants in groundwater using Geoprobe® grab sampling methods. The results of this effort indicated contaminants are present at the Site boundary along the northwest corner of the site (Figure 6). Based on these results, this RFI task is required to characterize the extent and potential source of groundwater contamination and to confirm earlier Geoprobe® results with permanent well installations. Accordingly, this task consists of the installation of Geoprobe® borings, installation of permanent monitoring wells along the northwest property boundary of the Site and sampling existing wells to investigate groundwater and the potential off-site groundwater contamination migration.

<u>Northwest</u>

The work scope for the northwest property boundary will consist of 1) installation of permanent wells at the Site boundary to confirm the lateral extent of contamination determined by the earlier Geoprobe sampling, and 2) further Geoprobe groundwater

grab sampling to delineate and characterize the extent and potential source of the contamination.

Monitoring wells to be used to confirm the lateral extent of contamination at the Site boundary includes existing wells MW-4603, MW-4604 and MW-4605, and wells MW-4604D, MW-4605D, MW-4623S, and MW-4623D installed as part of Task 2 above.

The data gathered during and subsequent to well installation will also be used to aid in the understanding of groundwater flow conditions and evaluate the vertical extent of contaminants in the groundwater in this area.

As previously discussed, the clay layer that separates the upper and lower sand unit is not present in the northwest area and the thickness of the lower sand is unknown. In addition, the vertical extent of contamination has not been delineated. Borings for MW-4604D, MW-4605D and MW-4623D will be installed to the first confining layer beneath the saturated sand layer (if present). MW-4623S will be installed approximately 25 feet bgs. Sampling and analysis of these monitoring wells are discussed above in Section 3.2.2.

To expedite the delineation and characterization of the chlorinated compounds in groundwater, groundwater samples will be collected using Geoprobe® sampling technology. Samples will be analyzed by a mobile laboratory with select confirmation samples submitted to the contract laboratory for TCL VOCs analysis. If the mobile laboratory is not deployed on-Site at the time of sampling, the samples will be submitted to the contract laboratory for TCL VOC analysis.

Sample locations will be identified in the field based on results from previous sample analyses and field results from the mobile laboratory. Samples may be collected in city right-of-ways, on commercial or residential properties or on-Site as required to delineate and characterize the groundwater. Access to city, commercial or residential property will be gained prior to sampling.

Continuous soil samples will be collected from approximately 50% of the sampling locations to determine soil stratigraphy. At locations where soil samples are collected, up to two soil samples from the saturated zones may be submitted to the laboratory for total organic carbon analysis.

At each sample location, one groundwater sample will be collected from the shallow saturated zone, when present, and up to two samples will be collected from the second saturated zone from approximately 20 ft and 30 ft bgs. Samples will be collected from

the Geoprobe® borings using the water column lift method. If groundwater cannot be obtained, soil samples will be collected from the desired depths.

The samples will be transported to a certified mobile laboratory deployed on-Site for analysis of TCE, DCE, and vinyl chloride. The mobile laboratory will analyze samples for this short list of target compounds to maximize the number of samples analyzed during the field event. A second set of samples will be collected and preserved in accordance with the FSP for potential confirmation analysis by the contract laboratory for TCL VOCs.

The criteria for field delineation of the lateral extent of the chlorinated compounds in groundwater are two adjacent groundwater sample location results for the target compounds below the mobile laboratory detection limits. The results of this sampling event will be used to determine placement of permanent Site monitoring wells as needed.

If required, a separate Interim Measures Work Plan will be developed to address migration control and source area investigation.

Southeast

The following will be completed during Field Event I in the southeast area of the Site:

- MW-4610D will be installed and clustered with the existing well MW-4610 and MW-4610S (discussed in Section 3.2.2).
- Groundwater samples will be collected from the above wells and MW-4117 and MW-4118. Sampling and analysis of these wells is discussed in Section 3.2.2.
- The above groundwater samples will be analyzed for TCL VOCs.
- A 4-point sampling grid will be installed as illustrated in Figure 7 to delineate chlorinated compounds in groundwater in the area. The proposed sampling locations are approximately 75 to 100 feet apart. Continuous split spoon sampling using Geoprobe drilling will be collected to obtain additional information about the soil stratigraphy in the area. At each sample location, two groundwater samples will be collected from each boring using the water column lift method from the upper and lower sand zones. If groundwater cannot be retrieved from the boring, saturated soil will be collected from the target intervals.

- The groundwater and/or soil samples from the Geoprobe sampling will be analyzed for TCA, TCE, DCE, and vinyl chloride by the certified mobile laboratory.

  The Geoprobe groundwater data collected as part of this task will be used to identify permanent well locations necessary to delineate the extent of contamination. The permanent wells will be installed as part of Field Event II. In addition to the above investigative work, soil borings will be installed around GP-4013 to delineate petroleum-based compounds that were detected in the boring for GP-4013. These soil borings are illustrated on Figure 7. A minimum of two soil samples will be collected from each boring. One sample will be collected from 0 to 2 feet bgs to evaluate direct contact exposures. Another sample will be collected from directly above the water table. A third sample may be collected between the shallow and deep samples if contamination is indicated by field screening of samples with a portable PID and/or visual observation. Samples will be analyzed for TCL VOCs and TCL SVOCs.

3.2.4 Task 4: Hydrogeologic Testing and Groundwater Characterization

The existing and new monitoring wells from Tasks 1, 2, and 3 above, will be used to collect water levels, test for hydraulic conductivity using slug tests, and sampled to gather groundwater quality information. The FSP contains the procedures to be followed for the above hydrogeologic testing activities.

In addition, the wells in the network (Figures 4 and 5) will be surveyed as part of Task 8 for horizontal and vertical control, (North American Vertical Datum or NAVD). Survey elevations will be to the nearest 0.01 feet. The water level and survey information will be used to calculate the water level elevations in individual wells. These data will subsequently be contoured to determine groundwater flow direction in the upper and lower saturated zones. These data will also be used to estimate the groundwater flux between the upper and lower saturated zones. Fifteen existing monitoring wells (Figure 4) and fourteen newly installed monitoring wells (Figure 5) will be sampled for groundwater characterization. The wells will be sampled according to the procedures provided in the FSP and samples will be analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, and TAL metals. The groundwater quality data will be used to evaluate groundwater quality conditions at the Site. In addition, the groundwater analytical data will be considered in selecting appropriate groundwater analyses to be undertaken during subsequent field events.

3.2.5 Task 5: AOI Monitoring Well Installations and Groundwater Characterization

In order to delineate the nature and extent, if any, of groundwater contamination, wells will be installed into the upper and lower sand zones. Monitoring wells will consist of a 10-foot (when possible), 2-inch diameter PVC well screen (No. 10 slot size), and a 2-inch diameter PVC riser. Details of the installation procedures are provided in the FSP. A minimum of three soil samples will be collected from each boring to evaluate soil quality conditions unless shallow groundwater conditions do not allow collection of the deeper samples. One sample will be collected from 0 to 2 bgs to evaluate direct contact exposures. Another sample will be collected from 8 to 10 feet to evaluate construction worker exposures. A third sample will be collected directly above the water table. A fourth sample may be collected between the samples if contamination is indicated by field screening of samples with a portable PID and/or visual observation. The soil samples will be analyzed as indicated for each AOI being investigated.

AOI 8 - Former Hard Chrome Plating Line (Building #4082)
The Former Hard Chrome Plating Line was installed in 1967 and operations were ceased in the mid-1990's. The area consists of a concrete pad, containment trenches, and two subgrade fiberglass-lined concrete vaults used to hold plating-related materials.

On June 1, 1987, it was reported that a release of chromic acid from an unknown source had occurred to a storm sewer (WC51) that was connected to the WWTP. In 1992, an investigation to determine potential sources of hexavalent chromium detected in the storm sewer was conducted. The investigation included a soil and groundwater sampling program around the Hard Chrome Plating Line and along associated underground piping. The investigation identified hexavalent chromium in soil samples collected in shallow soil along an abandoned process line. The concentrations of hexavalent chromium were documented as "none detected," "very trace," or "detected," therefore, no comparison to MDEQ Generic Clean-up Criteria is possible. The results indicated that hexavalent chromium was not present in groundwater surrounding the hard chrome plater.

Routine sampling of the storm sewer sump WC51 has been performed since 1986. Concentrations of hexavalent chromium ranged from non-detect to 150 mg/L. After the Hard Chrome Plating operations were discontinued, the concentrations of hexavalent chromium in the storm sewer ranged from non-detect to 0.2 mg/L.

The Documentation of Due Care Compliance identified a maximum concentration of hexavalent chromium in groundwater at 140 mg/L. However, the groundwater

concentrations cited appears to have been based on an interpretation that the stormwater sampling results were representative of groundwater. The concentration of hexavalent chromium in groundwater is not directly known, therefore one monitoring well cluster (MW-4622S & D, discussed in Task 2) will be installed and is intended to characterize groundwater quality in the vicinity of the Former Hard Chrome Plating Line. In addition, a minimum of one soil boring will be drilled in the area. Soil and groundwater samples will be obtained according to procedures in the FSP and analyzed for TAL metals, hexavalent chromium, and cyanide.

AOI 13 - Gridley Area

The Gridley Area is located in Building #4041, north of the former Power House. Operations in the Gridley Area involve metal machining operations. Scrap metal chips from the Gridley Area machining operations are collected and transported through a pipe along the roof to the chip collection area in the Automatic Screw Machine Basement (AOI 23).

Two tanks (#4005 and #4057) are associated with the Gridley Area. Tank #4005 was a 6,000-gallon UST used to store Clear Tex (a petroleum-based product). Tank #4005 was removed from service in December 1990 and replaced by Tank #4057, a 2,000-gallon above-ground storage which is used to store MTJ 468 Cutting Oil. In October 1991, an investigation of potential releases from Tank #4005 indicated the presence of benzene, toluene, ethylbenzene, and xylenes (BTEX) and total petroleum hydrocarbons (TPH) (9,000 mg/kg to 80,000 mg/kg) in soil samples.

Sampling of the monitoring wells in November 1991 indicated the presence of benzene, toluene, and xylenes in groundwater. Re-sampling of monitoring wells in February 1992 detected Light Non-Aqueous Phase Liquid (LNAPL) in one monitoring well. Samples of oils used in machining operations exhibited similar chromatographic signatures to that of the LNAPL encountered in the well. Based on groundwater elevations measured in June and September 1993, Environmental Consulting & Technology, Inc. (ECT) concluded that groundwater flow direction under the Gridley Area was to the northeast. ECT estimated the total volume of LNAPL beneath the Gridley area at 37,000 gallons.

ECT installed five free product recovery wells and approximately 14 monitoring wells in the Gridley area. Soil concentrations of metals, BTEX and Polynuclear Aromatic Hydrocarbons (PAHs) were less than Michigan Generic Cleanup Criteria (or Statewide Default Background for certain metals). Groundwater concentrations for BTEX, MTBE, and PAHs were less than MDEQ Generic Cleanup Criteria. Free product remains beneath the Gridley area.

Although the groundwater does not appear to be impacted by hazardous waste or hazardous constituents, free product remains in the area; accordingly, a Free Product Evaluation and Recovery Interim Measure will be implemented. A work plan for this activity is currently being prepared and will be submitted under separate cover. In the interim, three free product samples will be collected and analyzed for TCL VOCs, TCL SVOCs, TAL Metals, viscosity, and density.

3.2.6 Task 6: Soil Sampling and Analysis

The AOIs that were identified in the CCR for further investigation are shown on Table 1. The general investigation approach to determine if a release of chemicals of concern has occurred at these AOIs includes soil sampling, visual assessment, and field screening, as follows:

- All soil sampling will be biased to areas most likely to encounter the maximum contaminant levels at each AOI. For example, soil samples will be collected beneath through-going cracks at AOIs with cracked pavement/concrete. The use of biased samples allows fewer borings to be drilled during the first field event and is most useful for screening out AOIs based on likely maximum concentrations. A minimum of three borings will be drilled at each AOI. For larger areas where there are more than three areas of potential contamination (for example, AOI-25 - Former Fire Training Area), the number of borings will be determined by the size and nature of discrete disposal areas. This will allow one biased sample for each discrete disposal area.

- Boring depths will be to the top of the water table, which is approximately five to ten feet. A minimum of three soil samples will be collected from each boring unless shallow groundwater conditions do not allow collection of the deeper samples. One sample will be collected from 0 to 2 feet bgs to evaluate direct contact exposures. Another sample will be collected from 8 to 10 feet bgs to evaluate construction worker exposures. A third sample will be collected directly above the water table. A fourth sample may be collected between the samples if contamination is indicated by field screening of samples with a portable PID and/or visual observation.

- As noted throughout this plan, the depth to water at some areas of the Site can be relatively shallow. Also, several of the AOIs discussed below may have had releases at depths (i.e. tanks, sewers, sumps) that may be below the water table. Accordingly, the above soil sampling procedure may not be adequate for those AOIs where releases may have occurred below the water table. In

these cases, groundwater grab samples will be obtained using Geoprobe sampling methods in lieu of deeper soil sampling. The Geoprobe groundwater sampling method is provided in the FSP and AOIs where this sampling may be required are highlighted below.

- Soil sampling and decontamination of field sampling equipment will be undertaken according to the procedures provided in the FSP. Details on soil sampling at individual AOIs are provided below.

AOI 9 - Barrel, Rack, and U1 Plating Lines

The Barrel, Rack and U1 Plating Lines are located in Buildings #4051 and #4050, west of the former Hard Chrome Plater (AOI 8). Based on Site plans and interviews with Site personnel, plating operations began in this area in the 1950s. The operations currently conducted in this area include nickel, zinc, copper, and tin plating. Each plating line is contained within a trenched network. The trenches and process lines are connected to a series of wastewater sumps. Metal-bearing process wastewater from the plating area is transferred to the WWTP segregated from other process waste. Visual inspection of the sumps was not possible during the Site visit.

Four soil borings will be drilled and biased toward areas most likely to encounter maximum contaminant levels. Actual boring locations will be determined in the field. Soil samples collected from this area will be analyzed for TAL metals.

If the depth to groundwater is shallower than the suspected release depth at this AOI, one Geoprobe groundwater grab sample per boring will be analyzed for the above parameters.

AOI 14 - Phosphater

The Phosphater is located in Building #4081. According to Site personnel, the phosphater process involves the treatment of metal parts using iron- and nickel-sulfate cleaners and sulfuric acid. Wastewater from the phosphater is collected in an onsite process sewer that transported material to the Delphi WWTP. In the mid-1990's, the process sewer line from the phosphater was discovered to be corroded beneath Building #4081. The sewer line was lined and repaired in place.

An investigation on the potential impact of the sewer line on the subsurface was not performed, therefore three borings will be drilled along the formerly compromised process sewer line. Actual boring locations will be determined in the field based on information provided by facility personnel familiar with the process sewer line location. Soil samples will be analyzed for TAL metals and cyanide.

If the depth to groundwater is shallower than the suspected release depth at this AOI, one Geoprobe groundwater grab sample per boring will be analyzed for the above parameters.

AOI 16 - Udylite Coating
The Udylite Coating or spark plug blackener is located in Building #4081. The process uses Pentrate LM to generate a black oxide coating on spark plug components. The composition of Pentrate LM includes 30-40% sodium hydroxide, water and sodium nitrate. In addition to the Pentrate LM, the process can include the use of a sulfuric or hydrochloric acid wash. Approximately 1,690 lbs. of caustic sludge waste is generated per year by the process and is collected and disposed at an off-site landfill. Wastewater from the process is sent to the Delphi WWTP.

According to Site personnel, spills within the containment and trench system around the Udylite plater have occurred. During the Site visit, deteriorated concrete within the containment pad and trench system was noted.

Due to the past releases that have occurred on deteriorated concrete, three soil borings will be drilled and biased toward areas most likely to encounter maximum contaminant levels. Actual boring locations will be determined in the field. Soil samples will be analyzed for TCL SVOCs, TAL metals, and cyanide.

If the depth to groundwater is shallower than the suspected release depth at this AOI, one Geoprobe groundwater grab sample per boring will be analyzed for the above parameters.

AOI 18 – Former Zinc Dichromate Plating Lines (West Plating Lines)
The Zinc Dichromate Plating Lines are located in Building #4100. There were formerly three Zinc Dichromate Plating Lines in operation up to the early 1990s. One of the plating lines has been removed. Two of the plating lines remain but are no longer in service. Site personnel and Site records indicated a release from the adjacent Former Zinc Hydroxide Tanks (AOI 19). Based on visual observations by Haley & Aldrich personnel during the Site visit, the concrete pads and containment trenches were worn but appeared intact. A plating waste sump was identified within the containment area but inspection of the sump was not feasible during the Site visit.

Three borings will be drilled adjacent to the plating waste sump and the worn concrete area. Actual boring locations will be determined in the field based on information provided by facility personnel familiar with the tank location. Soil samples will be analyzed for TAL metals and cyanide.

If the depth to groundwater is shallower than the suspected release depth at this AOI, one Geoprobe groundwater grab sample per boring will be analyzed for the above parameters.

AOI 21 - Used Oil UST (Tanks #4032 and #4033)
USTs #4032 and #4033 are located beneath Building #4091. This building is currently used as an auditorium. According to Site records, Tanks #4032 and #4033 are 3,000-gallon and 10,000-gallon capacity, respectively. Tank #4032 was used to store ClearTex. According to Site personnel, Tank #4033 may have been utilized to store used oil but was filled with concrete in 1980. Although, the tank is listed as having been removed from service, the date removed from service and the current condition (removed or filled in place) is not known.

Five borings will be drilled adjacent to the tanks. Actual boring locations will be determined in the field based on information provided by facility personnel familiar with the tank location. Soil samples will be analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, and TAL metals.

If the depth to groundwater is shallower than the suspected release depth at this AOI, one Geoprobe groundwater grab sample per boring will be analyzed for the above parameters.

AOI 23 – Automatic Screw Machine Basement
The Automatic Screw Machine Basement located in Building #4133. The basement area is used to collect and distribute lubricating oils from the screw machines located on the main floor of Building #4133. During the Site visit, an oil seep was noted along the southern wall of the basement. It is noted that the Chip Collection Area (AOI 22) is located adjacent (southwest) of the Automatic Screw Machine Basement. Two sumps are located in the basement along the southeast and southwest walls and could not be observed.

Due to the inability to observe the condition of the sumps and the presence of the observed oil seep, three soil borings will be drilled adjacent to the sump and near the oil seep. Actual boring locations will be determined in the field. Soil samples will be analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, TAL metals. If depth to groundwater is shallower than the suspected release depth at this AOI, one Geoprobe groundwater grab sample per boring will be analyzed for the above parameters.

AOI 25 - Former Fire Training Area
The former fire training area is located east of Building #4175 at the edge of a concrete pad. According to Site personnel, the concrete area was used to demonstrate

and train Site personnel in the use of fire extinguishers. Site personnel did not have knowledge of specific fire training activities or the potential for a release in this area. Fire Department personnel were not available for interview to determine how any residual materials from the training exercises were handled. No evidence of a release was observed by Haley & Aldrich personnel during the Site visit.

The potential for a release in this area could not be determined, therefore five soil borings will be drilled in this area along the edge of the concrete in exposed soil. Actual boring locations will be determined in the field with the aid of Site personnel familiar with former activities in the area. Soil samples will be analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, TAL metals.

AOI 27 - Pump House/Lift Station and Eastern Process Sewer
The process wastewater sewer Pump House and Lift Station is located at Building #4171. According to Site personnel, a depression was forming on the south side of the Lift Station due to a damaged sewer line. In addition, in the mid-1990s approximately 100 yards of process wastewater sewer line north of the lift station was discovered to be corroded. The line was repaired in place.

Due to the potential for a release from the sewer prior to repair, ten soil borings will be drilled along the sewer line and adjacent to the pump house. Actual boring locations will be determined in the field. Soil samples will be analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, TAL metals.

If the depth to groundwater is shallower than the suspected release depth at this AOI, one Geoprobe groundwater grab sample per boring will be analyzed for the above parameters.

AOI 31 - Former Diesel UST Area (Tank #4052)
According to Site records, a 500-gallon UST was located between Buildings #4131 and #4095. The tank was used to store diesel oil. The tank was removed in December 1989, at which time six soil samples were collected from the excavation and analyzed for BTEX. The soil sample results were less than MDEQ Generic Cleanup Criteria. However, PAHs were not analyzed and may be more appropriate indicators of potential releases of diesel oil.

Due to the above-noted limitations of previous sampling results, one soil boring will be drilled adjacent to the former tank locations. The actual boring location will be determined in the field. Soil samples will be analyzed for TCL VOCs and TCL SVOCs.

If the depth to groundwater is shallower than the suspected release depth at this AOI, one Geoprobe groundwater grab sample per boring will be analyzed for the above parameters.

AOI 37 - Former Used Viscor UST & Sump Collection System
Tanks 4053 & 4054 and the associated Sump Collection System are located east of Building #4100. Tank 4053 is a 3,000-gallon capacity and stores virgin Viscor 381, and Tank 4054 stored used Viscor 381, a product used in the testing of fuel pumps. Used Viscor 381 was collected from the fuel pump testing area via underground piping connected to a sump housed in the northeast corner of Building #4100. The used Viscor 381 was then piped over the roof to Tank 4054.

Tank 4054 was managed as a Generator Underground Storage Tank under MDEQ Hazardous Waste Management regulations. Tank 4054 was cleaned and removed from service in September 1997. The MDEQ approved the closure of Tank 4054 as a Generator Underground Storage Tank in a letter dated 16 June 1998. Tank 4053 is still used to store virgin Viscor 381. Site personnel interviewed had no knowledge of a release associated with the tanks or collection system. The sump was filled with concrete in 1997.

Since the sump has been filled and was unable to be visually inspected during the Site visit, one soil boring will be drilled and biased toward areas most likely to encounter maximum contaminant levels. The actual boring location will be determined in the field. Samples will be analyzed for TCL VOCs, and TCL SVOCs.

AOI 45 - Compactor
The below grade Compactor is located in Building #4085 near the by-products area. This Compactor crushes scrap metal for recycling. Small amounts of oil periodically accumulate in the bottom of the vault. The oil drains to a collection sump in the vault where it is pumped into a 330-gallon portable tank (tote).

According to Site records, the oil in the tote was sampled and PCBs were detected in the samples. These results prompted sampling of the vault floor and PCBs were detected in these wipe samples. A release was reported to the National Response Center (NRC) on October 31, 1996. Several rounds of cleaning of the vault and sump and subsequent wipe sampling took place in November 1996. The extent of PCB contamination beyond the vault and sump of the Compactor was not determined.

Since the potential for a release to the adjacent soils cannot be determined, three soil borings will be drilled adjacent to the compactor. Actual boring locations will be

determined in the field. Soil samples will be analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, TAL Metals, and cyanide.

3.2.7 Task 7: Preliminary Exposure Assessment

A preliminary qualitative assessment will be conducted to characterize potential human exposures to environmental media at and adjacent to the Site. As part of this task, the current and reasonably expected future land and groundwater uses will be determined. In addition, potential exposure pathways by which on-site and off-site human exposures to constituents released from an AOI could occur will be identified.

A preliminary qualitative ecological assessment will be undertaken to identify potential ecological receptors. The assessment will include the identification of primary vegetation cover-types and dominant plant communities in terrestrial and wetland habitats, and a description of submerged and emergent habitat type and fish and invertebrate communities in aquatic habitats. The presence of birds and other wildlife will be determined by sight, sign, and song, and the presence or absence of special status species (e.g., threatened or endangered species) will be determined for the site area. Estimates of the aerial extent (e.g., in acres) of each habitat type will be derived from the aerial photographs using existing Geographic Information Systems (GIS) tools. As part of the assessment, the potential presence of wetlands will be assessed. The preliminary wetlands assessment will include visual observations of wetlands indications including the presence of wetlands flora and soil types indicative of wetlands environments. The data from this task will be used to determine if any sensitive ecological environments are present at the Site, to determine the potential presence of wetlands and to determine the potential for the presence of threatened or endangered species.

The habitat characterization will include a discussion of resources that might be provided to ecological receptors under current conditions as well as future site uses. Information developed during the habitat characterization will be evaluated with respect to data regarding the nature and extent of contamination at the site to determine whether there are any complete pathways of exposure to potential sensitive ecological receptors at the site.

3.2.8 Task 8: Site Survey

A site survey to determine elevations and locations of well installations, soil borings, etc, described above (Tasks 1, 2, 3, 5, 6, and 7), will be completed. It is noted that the Site survey will be undertaken periodically to allow for collection of timely and critical survey data. This includes surveying the wells installed during Task 2 after

their installation to allow for a timely evaluation of groundwater flow direction. Soil borings will also be surveyed after their installation to allow for timely boring log preparation.

3.2.9 Task 9: Soil Background

Due to limited undeveloped areas on site, soil samples collected during Task 2 from eight of the nine locations (MW-4622 series excluded) (Figure 5) from a depth of 0 – 2 feet bgs will be evaluated for use as natural background soil concentrations. These areas, with the exception of the excluded MW-4622 series, were selected for spatial coverage of the site, and are not associated with an AOI likely to contribute inorganic constituents to the surface soil. These samples will be evaluated to determine if the soil is impacted by site operations and construction ,and if samples are of natural (non-fill) material. Based on evaluation of the soil data collected during Field Event #1, additional background samples, as required, will be collected during Field Event #2.

3.3 Field Event II - Additional AOI Characterization

Monitoring Well Installations and Groundwater Characterization

At AOIs where soils have been impacted by chemicals of concern at concentrations that would likely impact groundwater, one shallow sand monitoring well will be installed at the location most likely to encounter groundwater contamination (i.e. at the downgradient edge of the AOI). The wells will be installed, developed, and hydraulic conductivity tested according to procedures in the FSP. After well installation, water levels will be obtained according to the procedures in the FSP. In addition, the newly installed wells will be surveyed for horizontal and vertical control. Survey elevations will be to the nearest 0.01 feet. The water level and survey information will be used to calculate the water level elevations in individual wells. These data will subsequently be contoured to determine groundwater flow direction.

The newly installed monitoring wells will be sampled according to the procedures described in the FSP. Groundwater sample analysis will consist of those chemicals of concern identified during the soil sampling activities at individual AOIs. The work scope for this groundwater sampling and analysis will be developed based on an evaluation of data collected during Field Event I. A work scope for additional sampling will be developed if required, and appended to this document after Field Event I data are evaluated.

Additional groundwater monitoring wells will be installed downgradient of areas with concentrations of constituents of concern greater than applicable screening criteria. Well

installations will continue until the extent of contamination above applicable screening criteria is delineated.

Subsequent sampling rounds will include analytes detected above screening criteria from any of the sampled wells. An addendum to this work plan will be prepared providing the details of routine/periodic groundwater monitoring. The addendum will include a subset of wells to be monitored, the analyses to be performed and the frequency to be monitored to demonstrate groundwater environmental indicators have been met.

In addition to AOIs identified during Field Event #1 activities, the following AOIs will be investigated during Field Event #2.

AOI 11 - Executive Garage Area
The Executive Garage Area is located in Building #4070 on the east side of the main manufacturing facility. Previous investigations of releases of petroleum products were performed at former USTs located in the outdoor areas surrounding the Executive Garage. The five USTs (Tanks #4007, 4034, 4035, 4036, and 4039) were utilized for gasoline storage. Tanks 4007, 4034, 4035, and 4036 were removed from the Site. According to Site records, Tank 4039 was filled in place with sand and the condition of the tank at the time of closure is unknown. Further investigation is not warranted in the Tank Areas that include Tanks 4007, 4034, 4035, and 4036.

Tank #4039
Based on Site records, Tank 4039 was closed in place by filling with sand in 1978. No closure samples were collected. The condition, integrity, and content of Tank #4039 prior to filling is unknown and the area of groundwater use restriction borders the area in which Tank #4039 was reported.

Due to its proximity to the groundwater use restriction area, AOI 11 will be investigated in Field Event #2 as groundwater flow direction and hydrogeologic interpretation occurs during Field Event #1.

AOI 22 - Chip Collection Area
The Chip Collection Area is located between Buildings #4107 and #4100. The Chip Collection Area is used to collect metal chips from the machining operations at the Gridley Area (AOI 13) in Building #4141 and the Automatic Screw Machines located in Building #4107 and #4133. Chips from these machining operations are transported in piping extending along the roof the Chip Collection Area which is an open tractor trailer located in a gravel covered alcove between the buildings. According to Site personnel, this area has been used to collect chips for over 25 years. Staining was noted on the gravel around the chip collection trailer and on the roof under the piping from the Gridley area.

Due to the presence of staining on gravel in the area, two monitoring wells will be installed and are intended to characterize groundwater quality in the vicinity of the Chip Collection Area. Groundwater samples will be obtained according to procedures in the FSP and analyzed for TCL VOCs, TCL SVOCs, TCL PCBs, and TAL Metals.

AOI 40 - Former Oleum UST (Tank #4023)
According to Site records, a 10,000-gallon UST was located east of Building #4050. Site records indicate the approximate historic location of the tank and that the tank was removed in the 1960's and contained Oleum, which was used as a lubricant for the extrusion of fuel filters. Site personnel interviewed had no knowledge of a release from the Former Oleum UST. However, the condition of the UST at the time of removal is unknown.

Since the condition of the tank at the time of removal is unknown, one monitoring well will be installed in the vicinity of the former tank location. Groundwater samples will be obtained according to procedures in the FSP and analyzed for TCL VOCs, TCL SVOCs, and TCL PCBs.

Soil Sampling and Analysis

Additional soil sampling may be required to further evaluate soil quality at selected AOIs including sump and sewer locations. The work scope for additional soil sampling and analysis will be developed based on an evaluation of data collected during Field Event I. A work scope for additional sampling will be developed if required, and appended to this document after Field Event I data are evaluated.

3.4 AOIs in the Process of MDEQ Closure

The following AOI was a Hazardous Waste Management Unit (HWMU) undergoing closure under the jurisdiction and direction of the MDEQ. However, it is understood that the MDEQ will allow corrective actions at the Container Storage Area (AOI 26) to proceed under the VCA agreement between the U.S. EPA and Delphi (19 September 2002).

AOI 26 - Container Storage Area
The Container Storage Area is located in the southeastern portion of the Site east of Building #4046. It was constructed in the 1940s and has been in continuous use for container storage since that time. The Container Storage Area was used primarily for the storage of drums and smaller containers of hazardous wastes prior to transportation for disposal off-site. Materials stored included ignitable and corrosive liquids, waste paints and paint sludges containing metals and hydrocarbon solvents, waste chlorinated solvents, and nickel-, cyanide- and cadmium-containing materials. All wastes were generated from plant operations.

The Container Storage Area was used for interim-status hazardous-waste storage between 1981 and 1988. In 1988, Delphi elected to close the storage area instead of obtaining a Part B permanent status RCRA permit. The storage area is now used as a less-than-90-day-storage area for hazardous wastes.

Closure of the Container Storage Area consisted of decontamination of the storage pad and staging areas. This was followed by a sampling and analysis program to determine if waste management practices during the interim status period resulted in soil and/or groundwater impact.

Results of the assessment indicated the presence of VOC contamination in soils and groundwater near the storage area greater than MDEQ Generic Cleanup Criteria. Results suggested that at least some of the observed impact was the result of waste management activities. Contamination was found in soils under concrete structures and in groundwater. The groundwater contamination was found to be limited to the uppermost saturated zone. There was no evidence to suggest that a lower saturated zone, located under 10 to 14 feet of confining clay, was adversely impaired. Based on these findings, clean closure of the Container Storage Area was not possible.

As stated above, Delphi converted this area to a less than 90-day accumulation unit. Closure activities including addressing hazardous constituents in contaminated media will be undertaken to complete the closure process. It is understood that the MDEQ will allow closure of the area to be completed under this Voluntary Corrective Action between Delphi and U.S. EPA Region V.

During Field Event I, groundwater samples will be collected from 14 of the existing monitoring wells around the Container Storage Area (Figure 4). These wells will be sampled for TCL VOCs, TCL SVOCs, TCL PCBs, and TAL metals. In addition, 4 groundwater samples will be analyzed for MNA analytical parameters to aid in the evaluation of natural attenuation end points and rates at the Site. These natural attenuation parameters include alkalinity, carbon dioxide, iron (II), pH, conductivity, temperature, redox potential, dissolved oxygen, chloride, nitrate, Kjeldahl nitrogen, ammonia nitrogen, sulfate, phosphorous, total iron, dissolved and total manganese, methane, ethane, ethene, total organic carbon and dissolved organic carbon. These data will be used to determine the current extent of groundwater contamination, to evaluate the potential remediation systems and, if required, to develop interim measures to address contamination this area.

IV. DATA EVALUATION

4.1 Objectives

The purpose of the investigation is to determine whether potential risk to human health and the environment associated with hazardous waste or constituents released at AOIs identified for investigation warrants interim or corrective measures. Data collected during the investigation will be used for the following:

- Determine whether a significant release of hazardous constituents to soil, groundwater, surface water, or sediment has occurred;
- Determine the nature and extent of constituents in soil and groundwater as necessary to support a baseline risk assessment, where a significant release of hazardous constituents has been confirmed;
- Support the RCRA corrective action Environmental Indicator Determinations; and
- Support the identification of AOIs that warrant interim or corrective measures, and evaluation of interim or corrective measures alternatives for these AOIs.

During the investigation, data collection will be conducted in phases. After each phase, adequacy of the data for their intended use will be evaluated as discussed below in Section 4.2 to determine whether additional data collection is warranted. When data of sufficient quality and quantity have been collected, they will be used to support decisions regarding the need for interim or corrective measures as discussed in Section 4.3.

4.2 Evaluation of Need for Additional Investigation

The primary purpose of data collection during the investigation is to provide sufficient characterization of the nature and extent of any releases of hazardous constituents to allow a reliable quantification of potential exposures from AOI-related constituent concentrations. That is, the analytical data collected during the investigation must be adequate for:

- Determining whether the concentration of a constituent in an environmental medium at an AOI is significantly above background levels (i.e., levels not attributable to the Site's operations) in that medium;
- Estimating the exposure concentration of a constituent in the medium in which the constituent was measured; and

- Estimating the exposure concentration of a constituent in a medium to which the constituent may migrate (e.g., volatilization of a soil constituent into ambient air).

To ensure adequacy for these intended uses, the analytical data will be evaluated in accordance with the procedures outlined in USEPA guidance on baseline risk assessments (U.S. EPA 1989).

One element in the evaluation of the analytical data will be a qualitative review of the data with respect to adequacy of the samples in characterizing the average concentrations of constituents for each exposure pathway identified as potentially relevant during the investigation. The qualitative review, using professional judgment, will include an examination of the following:

- Consistency in the types of constituents found in all sampled media at each AOI vis-a-vis expectations based on history of operations and chemical properties of the constituents, which may indicate potential for false negative or false positive identification of constituents.

- Lateral and vertical distribution of constituent concentrations to detect any obvious spatial trends, which may indicate that concentrations significantly higher than the measured concentrations may be likely in unsampled areas or depths.

- Presence of unusually high constituent concentrations, which may indicate the presence of nonaqueous-phase liquids.

If the qualitative review identifies conditions that are likely to cause risk-based assessments of the data to indicate unreliable conclusions regarding the need for interim or corrective measure, further sampling or other actions (e.g., checking for laboratory errors) will be undertaken to address such conditions.

In conjunction with the qualitative review, the data will be evaluated using appropriate, conservative human health and ecological risk-based screening levels to identify potentially significant concentrations. This screening will be conducted on each data point generated during the investigation. The presence of concentrations higher than screening levels will not necessarily mean that additional investigation is warranted. Similarly, the absence of concentrations higher than screening levels will not necessarily mean that additional investigation is unnecessary. Rather, decisions regarding the need for further investigation will be made based on professional judgment considering the screening results and results of the qualitative review discussed above, including the magnitude of the concentrations, their spatial distribution, and other factors (e.g., background levels, as discussed below).

The analytical data also will be reviewed to identify constituents that are present at concentrations in an environmental medium that are within background levels in that medium.

- For constituent concentrations measured in soil, the constituent concentrations will be compared with site-specific background levels in soil using a statistical prediction interval at a 0.01 level of significance. If a soil constituent is determined to be within background levels in soil, then it would not be considered for quantitative exposure assessment for soil-related exposure pathways.

- For constituents in groundwater, the concentration of a constituent in a monitoring well downgradient of an AOI will be compared with the maximum concentration measured in the monitoring wells upgradient of the Site. If a groundwater constituent is determined to be within site-specific background levels in groundwater, then it would not be considered for quantitative exposure assessment for groundwater-related exposure pathways.

Although all laboratory analytical data collected during the investigation will be validated as discussed in the QAPP, the evaluation of data after each phase of investigation will be conducted without waiting for data validation to be completed. This will allow for more timely decisions regarding the need for further field investigations. However, the use of data to support decisions regarding the need for interim or corrective measures will be based on validated data.

4.3 Use of Investigation Data

The objective of the investigation is to determine whether potential risk to human health and the environment associated with hazardous waste or constituents released from the AOIs identified for investigation warrants interim or corrective measures. The determination will rely on a risk-based assessment (which could be a baseline risk assessment) that will characterize the potential human health risk associated with each AOI from reasonable exposures under current and reasonably expected future land and groundwater uses at and near the Site. An ecological risk assessment may be conducted on a site-wide basis (if necessary) taking into account the potential presence of threatened and endangered species, the presence of ecological populations and communities of valued ecological resources, habitat restrictions, and pathways of exposure for ecological receptors.

The risk assessments will include development of exposure scenarios, consistent with current and reasonably expected future land and groundwater uses, that describe potential exposure pathways by which on-site and off-site human and ecological populations may become exposed to constituents released from an AOI. Documentation to confirm reasonably expected future land and groundwater uses, the potential presence of threatened or endangered

species, and the existing habitats will be developed during the investigation for the baseline risk assessments. The physical characteristics of the Site, including topography, hydrology, hydrogeology, geology and ecology will be evaluated in conjunction with chemical data to assess chemical fate and transport mechanisms. This information will be used to assess the current and potential future impact, if any, of the releases identified at an AOI.

V. REPORTS

5.1 Progress Reports

The results of the RFI will be presented in the RFI Report. During the course of the RFI, Delphi will prepare and submit to the U.S. EPA quarterly progress reports which will include the following sections:

- Work performed to date
- Data collected
- Problems encountered
- Project schedule
- Percent project completed

5.2 Interim Data Reports

Interim data reports will be prepared at the completion of each field event. The data reports will present data that have been gathered as part of each field event, and will present an analysis of the data that was gathered during each event. The interim data reports will also identify any follow-up investigations required to complete the RFI.

5.3 Environmental Indicators Report

An Environmental Indicators Report will be prepared and will document the assessment of current risks to human health and a status of groundwater migration issues. The report will demonstrate/document that unacceptable known exposures, at or from the Site are under control. In addition, the report will document that migration of contaminated groundwater, at or from the Site, is stabilized. It is noted that the completion of the Human Health Environmental Indicators (EI) Report assumes that adequate data can be collected for the EI determination during Field Event I and Field Event II. If additional data is required due to unexpected conditions, the scheduled date for the Human Health EI Report may be delayed. The U.S. EPA will be notified if this situation arises.

5.4 Final RFI Report

The Final RFI Report will present all data that have been gathered as part of the investigation. The RFI Report will present an analysis of the data that was gathered and will present conclusions about the status of the Site. The RFI Report will also present the baseline risk

assessment (including both human and ecological risk evaluations) and a recommendation for the completion of a Corrective Measures Study (CMS), if warranted.

Any data deficiencies identified in the RFI that may hinder the completion of the CMS will be corrected by collecting additional data during the CMS process.

VI. RFI WORK PLAN SCHEDULE

The schedule of RFI Work Plan implementation is summarized in Figure 8 and is based on the VCA agreement between the U.S. EPA and Delphi. It is noted that completion of the Human Health Environmental Indicators Report assumes that adequate data can be collected for the EI determination during Field Event I and Field Event II. If additional data is required due to unexpected conditions, the scheduled date for the Human Health EI Report may be delayed.

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TABLE 1
AREAS OF INTEREST TO BE INVESTIGATED
FLINT-EAST - PLANT 400
FLINT, MICHIGAN

AOI Designation	
AOI-8	Former Hard Chrome Plating Line (Building #4082)
AOI-9	Barrel, Rack, and U1 Plating Line
AOI-11	Executive Garage
AOI-13	Gridley Area (Interim Measures Work Plan)
AOI-14	Phosphater
AOI-16	Udylite Plating
AOI-18	Former Zinc Dichromate Plating Lines (West Plating Lines)
AOI-21	Used Oil USTs #4032 and #4033
AOI-22	Chip Collection Area
AOI-23	Automatic Screw Machine Basement
AOI-25	Former Fire Training Area
AOI-26	Container Storage Area
AOI-27	Pump House/Lift Station and Eastern Process Sewer
AOI-31	Former Diesel UST (Tank #4052)
AOI-37	Former Waste Viscor UST & Sump Collection System
AOI-40	Former Oleum UST (Tank #4023)
AOI-45	Compactor
AOI-48	Groundwater

TABLE 2
SCOPE OF WORK - FIELD EVENT I
FLINT-EAST - PLANT 400
FLINT, MICHIGAN

	AOI Designation	Description of Waste or Product	Proposed Field Investigation	Number of Groundwater Samples	Number of Soil Samples	Proposed Analytical Investigation
Groundwater Investigations						
AOI-8	Former Hard Chrome Plating Line (Building #4082)	Hexavalent Chromium	Install 2 monitoring wells, 1 soil boring (soil samples will be collected from these borings)	2	2	TAL Metals, hexavalent chromium, cyanide
AOI-11	Executive Garage Area	Gasoline	Groundwater flow and hydrogeologic interpretation, soil borings to determine the extent of gasoline constituents	TBD	TBD	TCL VOCs, TCL SVOCs, and lead
AOI-13	Gridley Area	Clear Tex (petroleum-based), cutting oil	[IM Work Plan will be submitted under separate cover]		-	
AOI-22	Chip Collection Area	Cutting Oil	Install 2 monitoring wells	2	-	TCL VOCs, TCL SVOCs, TCL PCBs, TAL Metals
AOI-40	Former Oleum UST (Tank #4023)	Oleum (lubricant)	Install 1 monitoring well	1	-	TCL VOCs, TCL SVOCs, TCL PCBs
AOI-48	Groundwater	TCE and Vinyl Chloride	Installation of monitoring wells and soil borings to determine extent of vinly chloride and TCE contamination	TBD	TBD	TCL VOCs
	Site-wide Groundwater Sampling		Groundwater Quality Information will be collected from selected existing and new monitoring wells.	29	-	TCL VOCs, TCL SVOCs, TAL Metals, TCL PCBs,
Soil Investigations						
AOI-9	Barrel, Rack, and U1 Plating Line	Metal-bearing Wastewater	Install 3 soil borings	-	6	TAL Metals
AOI-14	Phosphater	iron-sulfate, nickle-sulfate, sulfuric acid	Install 3 soil borings	-	6	TAL Metals and cyanide
AOI-16	Udylite Coating	sodium hydroxide, sodium nitate, sulfuric and hydrochloric acids	Install 3 soil borings	-	6	TCL VOCs, TCL SVOCs, TAL Metals, and cyanide
AOI-18	Former Zinc Dichromate Plating Lines (West Plating Lines)	Zinc Hydroxide	Install 3 soil borings	-	6	TAL Metals and cyanide
AOI-21	Used Oil UST Tanks #4032 and #4033	Clear Tex (petroleum-based), Waste oil	Install 5 soil borings	-	10	TCL VOCs, TCL SVOCs, TCL PCBs, TAL Metals
AOI-23	Automatic Screw Machine Basement	Lubricating Oils	Install 3 soil borings	-	6	TCL VOCs, TCL SVOCs, TCL PCBs, TAL Metals

Notes:
see Page 2

TABLE 2
SCOPE OF WORK - FIELD EVENT I
FLINT-EAST - PLANT 400
FLINT, MICHIGAN

AOI Designation		Description of Waste or Product	Proposed Field Investigation	Number of Groundwater Samples	Number of Soil Samples	Proposed Analytical Investigation
Soil Investigations (continued)						
AOI-25	Former Fire Training Area	Flammable Materials and Liquids (unknown)	Install 5 soil borings	-	10	TCL VOCs, TCL SVOCs, TCL PCBs, and TAL Metals
AOI-27	Pump House/Lift Station and Eastern Process Sewer	Process Wastewater	Install 10 soil borings	-	20	TCL VOCs, TCL SVOCs, TAL Metals
AOI-31	Former Diesel UST (Tank #4052)	Diesel Oil	Install 1 soil boring	-	3	TCL VOCs, TCL SVOCs
AOI-37	Sump Collection System (Former Used Viscor UST)	Viscor 381 and waste Viscor 381	Install 1 soil borings	-	3	TCL VOCs, TCL SVOCs
AOI-45	Compactor	PCBs	Install 3 soil borings	-	3	TCL VOCs, TCL SVOCs, TCL PCBs, TAL Metals, and cyanide
Container Storate Area Closure						
AOI-26	Container Storage Area		Monitoring Well Sampling and Closure Work Plan	-	-	

Notes:
1. Actual number of soil samples collected will be based on field conditions including depth to groundwater, field screening, and visual observations.
2. TBD - To Be Determined

TABLE 3
MONITORING WELL INVENTORY
FLINT-EAST - PLANT 400
FLINT, MI

Well ID	Located Y/N	Date	PID Headspace (ppm)	Depth To Water (ft)	Depth To Bottom (ft)	Constructed Depth (ft)	Constructed Depth Minus Current Depth (ft)	Notes	Recommendations
MW-4001	N							abandoned	
MW-4002	N							abandoned	
MW-4003	Y	9/10/01				14.5		inaccessible	open, replace well cap and lock, determine further action
MW-4004	Y	9/10/01	--	7.79	12.13	16.0	3.87		re-develop, replace well cap and lock
MW-4005	Y	9/10/01				18.0		inaccessible	open, replace well cap and lock, determine further action
MW-4006	N							abandoned	
MW-4007	N							abandoned	
MW-4101	Y	9/12/01	0.0	7.99	10.96	13.0	2.04		re-develop, replace well cap and lock
MW-4102	Y	9/12/01	0.1	8.83	11.32	12.5	1.18		re-develop
MW-4103	Y	9/12/01	0.1	8.80	11.51	12.0	0.49		re-develop, replace well cap and lock
MW-4104	Y	9/12/01	0.3	8.66	11.16	13.5	2.34		re-develop
MW-4105	Y	9/12/01	0.0	7.85	10.50	10.5	0.00		determine cost of replacing surface casing and cap vs. abandonment
MW-4106	Y	9/12/01	0.8	3.95	8.05	10.5	2.45		re-develop
MW-4107	Y	9/12/01	0.0	13.75	26.74	NC			re-develop, replace lock
MW-4108	N							abandoned	
MW-4109	Y	9/12/01	0.0	7.75	10.82	11.5	0.68		remove obstruction, re-develop, abandon if obstruction not removed
MW-4110	Y	9/12/01	0.0	6.28	10.40	12.0	1.60		re-develop, replace lock
MW-4111	Y	9/12/01				NC		inaccessible	open, replace well cap and lock, determine further action
MW-4112	Y	9/12/01	0.0	14.45	30.11	NC			
MW-4113	Y	9/12/01	0.1	13.11	28.49	NC			Abandon (bentonite in well, broken PVC riser)
MW-4114	Y	9/12/01				12.0		inaccessible	open, determine further action
MW-4115	Y	9/12/01	0.0	7.70	8.61	12.0	3.39		re-develop
MW-4117	Y	9/13/01	0.0	--	9.50	12.0	2.50		re-develop
MW-4118	Y	9/13/01	0.0	9.17	9.20	12.0	2.80		re-develop
MW-4119	Y	9/12/01				12.0		inaccessible	open, determine further action, repair cracked well pad
MW-4120	Y	9/12/01				12.0		inaccessible	open, replace well cap and lock, determine further action
MW-4121	Y	9/12/01	0.0	9.39	14.82	17.0	2.18		re-develop
MW-4401	Y	9/10/01	0.0	12.60	12.91	16.0	3.09		DNAPL at depth 9.71, replace lock
MW-4402	Y	9/10/01				16.0		inaccessible	open, replace well cap and lock, determine further action
MW-4403	Y	9/10/01				16.0		inaccessible	open, replace well cap and lock, determine further action
MW-4404	Y	9/10/01	0.0	10.18	12.60	16.0	3.40		re-develop, replace lock
MW-4405	Y	9/10/01	0.0	10.53	13.20	15.0	1.80		re-develop, replace lock
MW-4406	N					16.0		not located	
MW-4407	N					14.0		not located	
MW-4408	Y	9/10/01				13.0		inaccessible	open, determine further action
MW-4410	Y	9/13/01	0.0	11.73	12.70	12.5	-0.20		DNAPL at depth 10.06, replace lock
MW-4411	Y	9/10/01	0.0	11.33	13.79	NC			re-develop, replace lock
MW-4412	Y	9/10/01	0.0	11.64	12.41	NC			re-develop, replace lock
MW-4413	Y	9/10/01	3.1	12.67	12.69	NC			DNAPL at depth 11.08, replacing surface casing and cap
MW-4414	N					NC		abandoned	
MW-4415	Y	9/13/01	0.0	–	12.10	NC			DNAPL at depth 11.78, replace lock
MW-4416	Y	9/13/01	0.0	11.99	12.95	NC			re-develop, replace lock
MW-4501	N							abandoned	
MW-4502	Y	9/13/01	0.0	7.95	9.10	10.0	0.90		re-develop, replace lock

TABLE 3
MONITORING WELL INVENTORY
FLINT-EAST - PLANT 400
FLINT, MI

Well ID	Located Y/N	Date	PID Headspace (ppm)	Depth To Water (ft)	Depth To Bottom (ft)	Constructed Depth (ft)	Constructed Depth Minus Current Depth (ft)	Notes	Recommendations
MW-4503	N					14.0		not located	
MW-4601	Y	9/11/01	0.0	8.77	11.25	13.5	2.25		re-develop
MW-4602	N					15.0		not located	
MW-4603	Y	9/11/01	0.0	14.66	18.39	19.0	0.61		re-develop
MW-4604	Y	9/11/01	–	17.13	20.45	20.0	-0.45		re-develop
MW-4605	Y	9/11/01	–	17.90	21.50	20.0	-1.50		re-develop
MW-4606	Y	9/11/01	–	9.41	12.49	14.5	2.03		re-develop
MW-4607	Y	9/12/01	0.3	8.68	13.85	16.0	2.15		re-develop, replace lock
MW-4608	Y	9/13/01	0.0	6.40	11.81	14.5	2.69		re-develop, replace lock
MW-4609	Y	9/13/01	0.0	5.88	12.38	12.5	0.12		
MW-4610	Y	9/13/01	0.0	16.25	23.76	24.0	0.24		
MW-4611	Y	9/13/01	0.0	**	**	NC			Abandon (bent riser)
MW-4612	Y	9/11/01	0.0	18.00	20.50	17.0	-3.50		re-develop
MW-4613	Y	9/11/01	0.0	15.03	15.48	13.5	-1.98		re-develop
MW-4614	Y	9/13/01	0.0	9.30	12.95	14.0	1.05		re-develop
MW-4615	Y	9/25/01		*	*	24.0			re-develop
P-1	N					NC		not located	no action
RECOVERY WELL	N							not located	no action
RW-1	N					NC		not located	no action
RW-7	N					NC		not located	no action
RW-8	Y	9/10/01				NC			no action
RW-9	Y	9/10/01				NC			no action
RW-4003	Y	9/10/01							no action

Notes:
1. NC=No Construction logs are available for review.
*=Monitoring well was located after inventory was complete.
**=Riser was bent; water level indicator probe would not fit.
– Groundwater was not encountered.

TABLE 4
TARGET PARAMETERS - GROUNDWATER
FLINT-EAST - PLANT 400
FLINT, MICHIGAN

COMPOUND	GROUNDWATER QUANTITATION LIMITS (ug/L)	SOIL QUANTITATION LIMITS (ug/kg)
Volatile Organic Compounds		
Acetone	730	
Benzene	5	
Bromodichloromethane	100	
Bromoform	100	
Bromomethane	10	
2-Butanone	13000	
Carbon disulfide	800	
Carbon tetrachloride	5	
Chlorobenzene	100	
Dibromochloromethane	100	
Chloroethane	430	
Chloroform	100	
Chloromethane	260	
Cyclohexane	33000	
1,2-Dibromo-3-chloropropane	0.2	
1,2-Dibromoethane	1	
1,2-Dichlorobenzene	5	
1,3-Dichlorobenzene	6.6	
1,4-Dichlorobenzene	75	
Dichlorodifluoromethane	1700	
1,1-Dichloroethane	880	
1,2-Dichloroethane	5	
cis-1,2-Dichloroethene	70	
trans-1,2-Dichloroethene	70	
1,1-Dichloroethene	7	
1,2-Dichloropropane	5	
cis-1,3-Dichloropropene	21	
trans-1,3-Dichloropropene	21	
Ethylbenzene	74	
2-Hexanone	1000	
Isopropylbenzene	800	
Methyl acetate	6100	
Methylcyclohexane	5200	
Methylene chloride	5	
4-Methyl-2-pentanone	1800	
Methyl tert-butyl ether	40	
Styrene	100	
1,1,2,2-Tetrachloroethane	5	
Tetrachloroethene	5	
Toluene	790	
1,2,4-Trichlorobenzene	70	
1,1,1-Trichloroethane	200	
1,1,2-Trichloroethane	5	
Trichloroethene	5	
Trichlorofluoromethane	2600	
1,1,2-Trichloro-1,2,2-trifluoroethane	1.70E+05	
Vinyl chloride	2	
Xylenes (total)	280	

TABLE 4
TARGET PARAMETERS - GROUNDWATER
FLINT-EAST - PLANT 400
FLINT, MICHIGAN

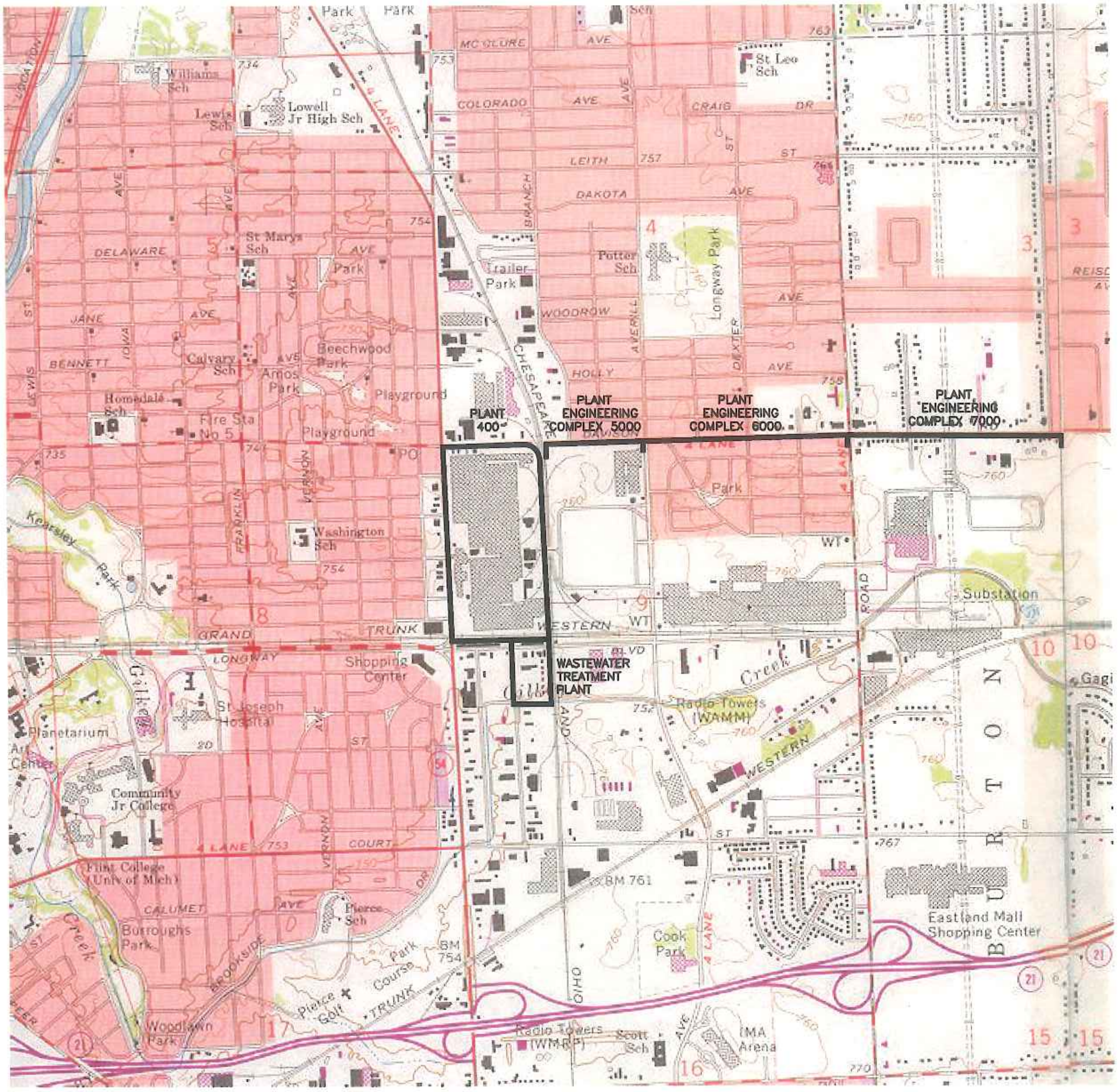
COMPOUND	GROUNDWATER SCREENING CRITERIA (ug/L)	SOIL SCREENING CRITERIA (mg/kg)
METALS		
Arsenic	50	23
Antimony	6	0.5
Barium	2000	1300
Beryllium	4	51
Cadmium	5	6
Chromium IV	100	3.3
Chromium	100	100000
Cobalt	40	0.8
Copper	1000	5800
Lead	4	700
Manganese	50	1
Nickel	100	100
Selenium	50	0.4
Silver	34	4.5
Thallium	2	2.3
Vanadium	4.5	72
Zinc	2400	2400
SEMI-VOLATILE ORGANIC COMPOUNDS		
Acenaphthene	1300	4400
Acenaphthylene	52	5900
Acetophenone	1500	30000
Anthracene	43	41000
Atrazine	3	60
Benzaldehyde	3600	6100000
Benzo(a)anthracene	2.1	20000
Benzo(b)fluoranthene	2.0	20000
Benzo(k)fluoranthene	5.0	200000
Benzo(ghi)perylene	5.0	2500000
Benzo(a)pyrene	2.0	2000
1,1'-Biphenyl	NA	NA
bis(2-Chloroethoxy)methane	NA	NA
bis(2-Chloroethyl) ether	2	330
bis(2-Ethylhexyl) phthalate	2800	2800000
4-Bromophenyl phenyl ether	NA	NA
Butyl benzyl phthalate	310	310000
Caprolactam	120	120000
Carbazole	9.4	94000
4-Chloroaniline	150	94000
4-Chloro-3-methylphenol	5.8	58000
2-Chloronaphthalene	NA	NA
2-Chlorophenol	150	900
4-Chlorophenyl phenyl ether	NA	NA
Chrysene	5	NA
Dibenz(a,h)anthracene	2	2000
Dibenzofuran	1.7	1700
Di-n-butyl phthalate	760	750000
3,3'-Dichlorobenzidine	NA	2000
2,4-Dichlorophenol	73	1500
Diethyl phthalate	110	110000
2,4-Dimethylphenol	370	7400

TABLE 4
TARGET PARAMETERS - GROUNDWATER
FLINT-EAST - PLANT 400
FLINT, MICHIGAN

SEMI-VOLATILE ORGANIC COMPOUNDS	GROUNDWATER SCREENING CRITERIA (ug/L)	SOIL SCREENING CRITERIA (ug/kg)
Dimethyl phthalate	790	790000
4,6-Dinitro-2-methylphenol	20	1700
2,4-Dinitrophenol	73	120000
2,4-Dinitrotoluene	22	430
2,6-Dinitrotoluene	15	61000
Di-n-octyl phthalate	64	100000000
Fluoranthene	16	730000
Fluorene	3900000	730000
Hexachlorobenzene	1.8	1800
Hexachlorobutadiene	26	26000
Hexachlorocyclopentadiene	320	320000
Hexachloroethane	7.3	430
Indeno(1,2,3-cd)pyrene	2	20000
Isophorone	770	15000
2-Methylnaphthalene	260	57000
2-Methylphenol	71	1400
4-Methylphenol	71	1400
Naphthalene	520	35000
2-Nitroaniline	2.1	3500
3-Nitroaniline	NA	NA
4-Nitroaniline	NA	NA
Nitrobenzene	3.4	200
2-Nitrophenol	NA	NA
4-Nitrophenol	290	NA
N-Nitrosodiphenylamine	270	5400
N-Nitrosodi-n-propylamine	5	330
2,2'-oxybis(1-Chloropropane)	1	NA
Pentachlorophenol	1	22
Phenanthrene	52	5600
Phenol	4400	88000
Pyrene	140	480000
2,4,5-Trichlorophenol	730	39000
2,4,6-Trichlorophenol	120	2400
CYANIDE		
Total Cyanide	5.2	0.4
POLYCHLORINATED BIPHENYLS		
Aroclor 1016	0.2	3900
Aroclor 1221	0.034	220
Aroclor 1232	0.034	220
Aroclor 1242	0.034	220
Aroclor 1248	0.034	220
Aroclor 1254	0.034	220
Aroclor 1260	0.034	220

Notes and Abbreviations:
NA - Screening Criteria Currently Not Available

Reference:
Michigan Department of Environmental Quality (MDEQ) Part 201, Natural Resources and Environmental Protection Act, Attachment A Generic Cleanup Criteria and Screening Levels, Revised December 2002.



USGS QUADRANGLE: FLINT NORTH, MICH.
1969, photorevised 1975

HALEY & ALDRICH

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

DELPHI ENERGY AND CHASSIS SYSTEMS
PLANT 400 – 1300 NORTH DORT HIGHWAY
FLINT, MICHIGAN

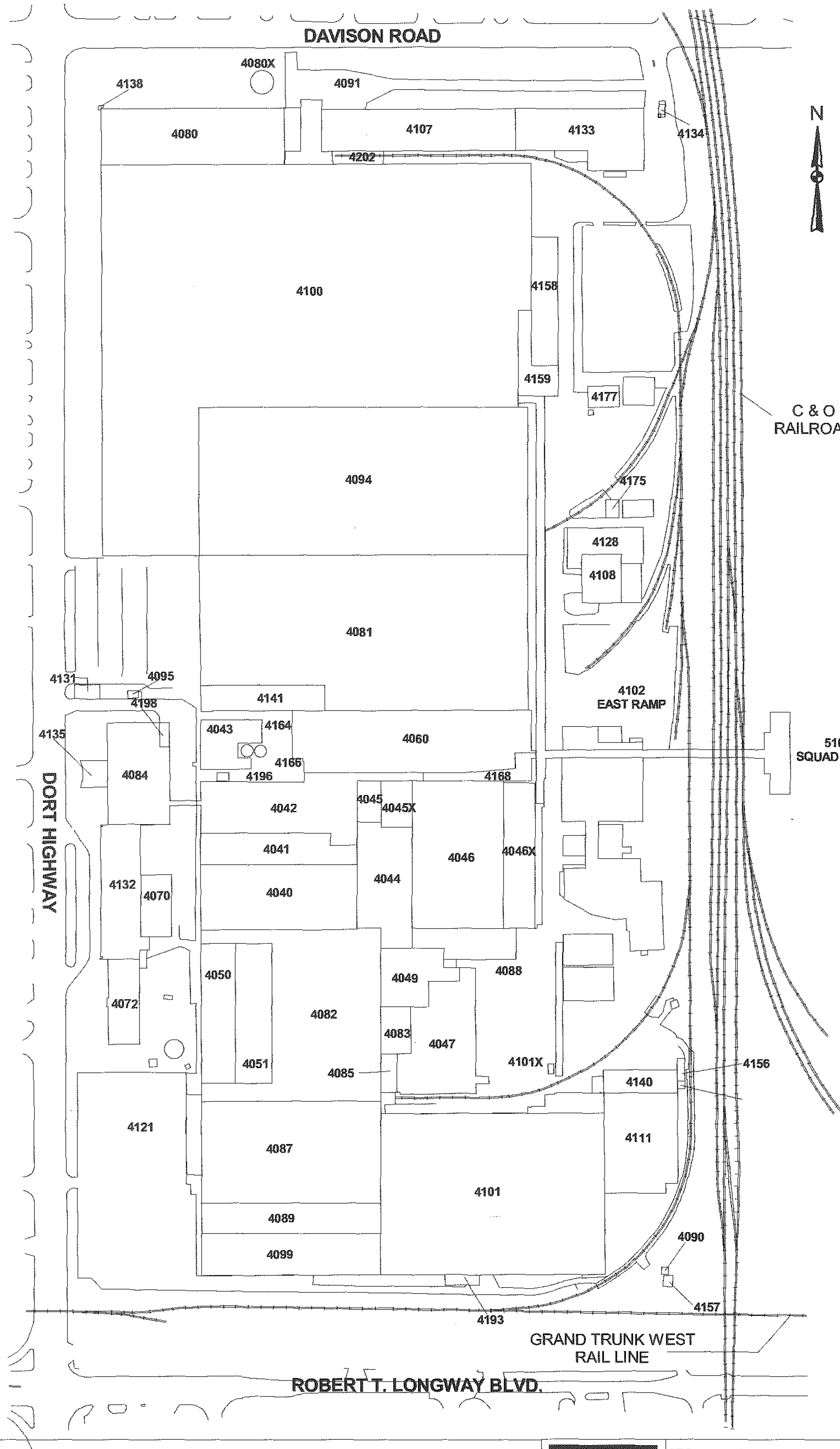
SITE LOCATION MAP

SCALE: 1 IN. = 24,000 FT.

NOVEMBER 2002

FIGURE 1

G:\49017\001\DOCC\March2001\Figures\Figure_1.dwg



Legend:

4101	Building outline with number designation

Notes:

1. Base plan provided by Delphi Corporation.

60 0 60 120 Feet

HALEY & ALDRICH

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

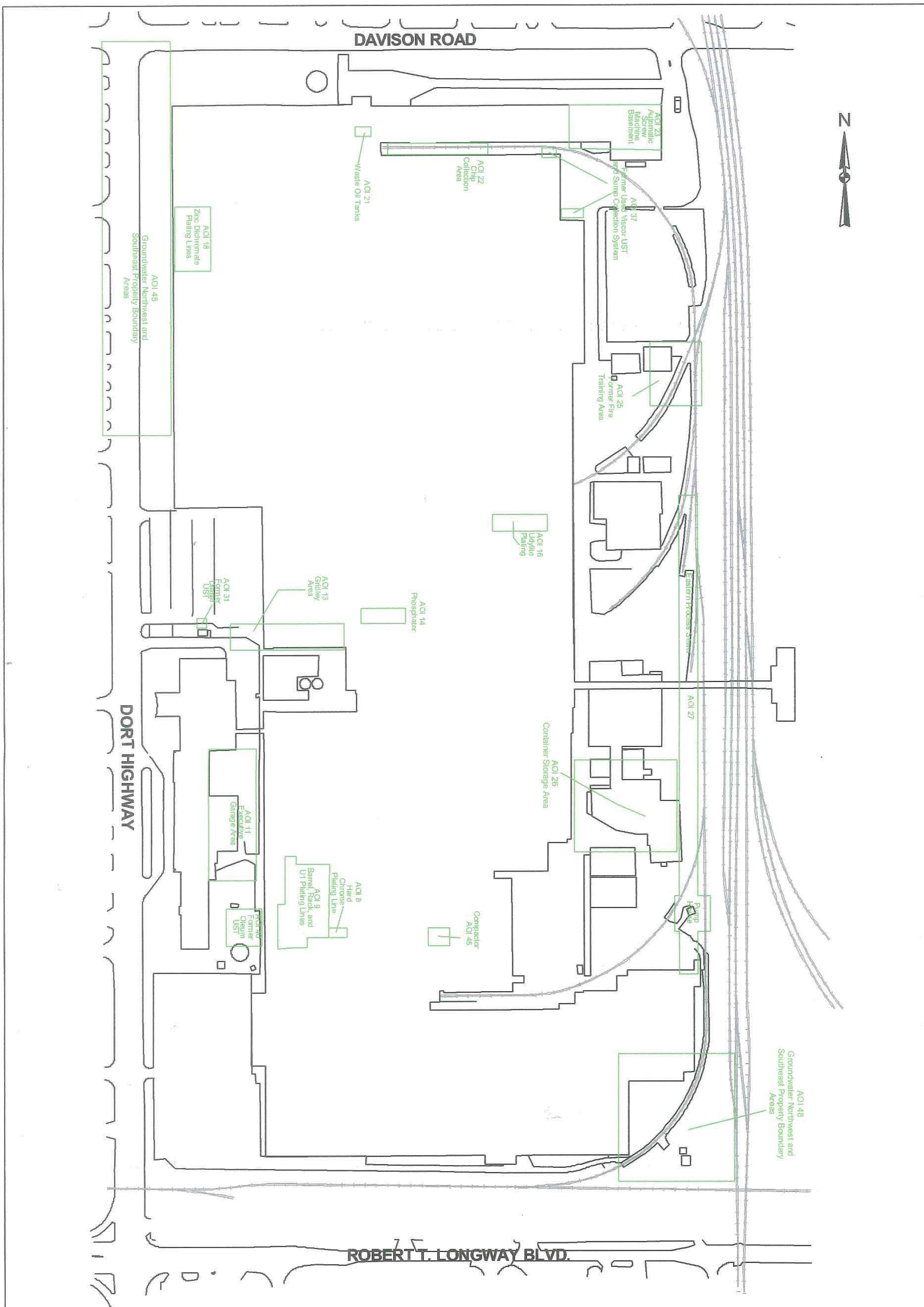
DELPHI CORPORATION
PLANT 400\DORT HIGHWAY
FLINT, MICHIGAN

SITE PLAN

SCALE: AS SHOWN

AUGUST 2002

FIGURE 2



Legend:

Areas of Interest

100 0 100 200 Feet

Notes:

1. Base plan provided by Delphi Corporation.
2. AOI 48 - Groundwater addresses site-wide groundwater conditions.

rfi_wp_figures1.apr

HALEY & ALDRICH

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

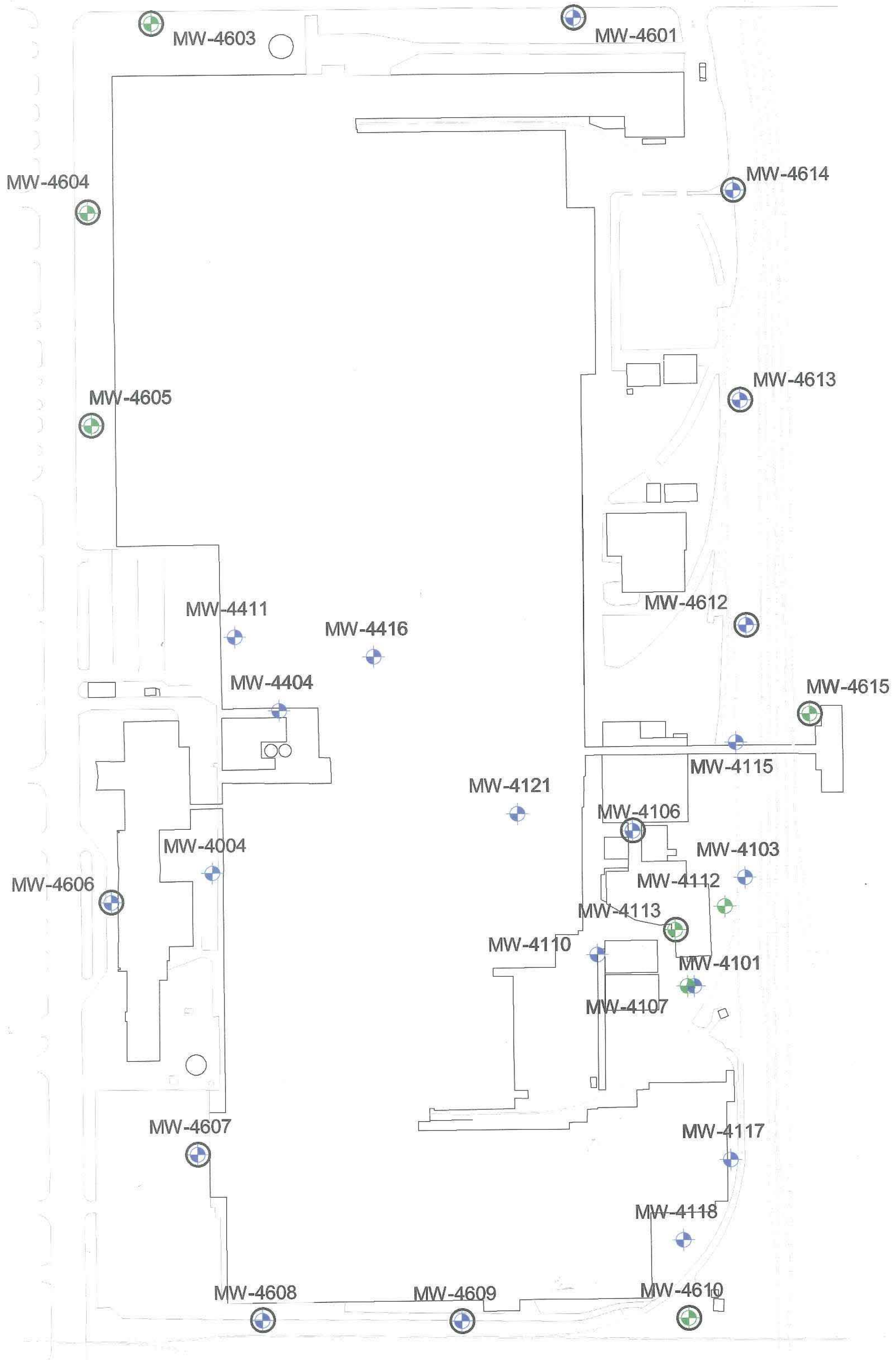
DELPHI CORPORATION
PLANT 400/DORT HIGHWAY
FLINT, MICHIGAN

AREAS TO BE INVESTIGATED

SCALE: AS SHOWN

MARCH 2003

FIGURE 3



LEGEND:

- Existing monitoring wells screened in the shallow groundwater zone.
- Existing monitoring wells screened in the deep groundwater zone.
- Proposed wells to be included in site-wide groundwater characterization sampling.

NOTES:

1. Locations are approximate.
2. Base plan provided by Delphi Automotive Systems.

100 0 100 200 Feet

HALEY & ALDRICH

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

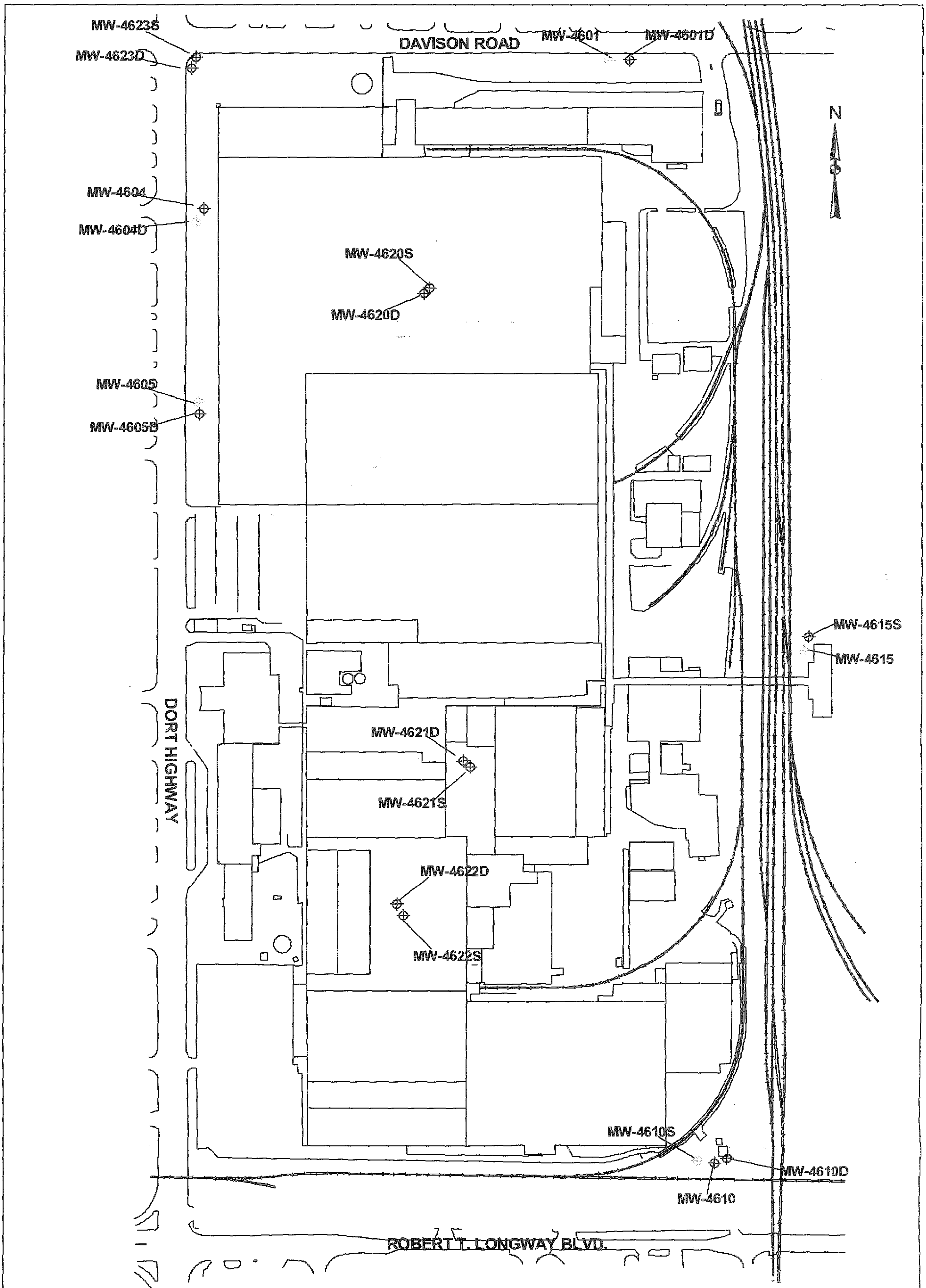
DELPHI AUTOMOTIVE SYSTEMS
PLANT 400/DORT HIGHWAY
FLINT, MICHIGAN

EXISTING MONITORING WELLS TO BE USED DURING THE RFI FIELD EVENT I

SCALE: AS SHOWN.

DECEMBER 2001

FIGURE 4



Legend:

Building outline

Proposed Monitoring Well Location

Existing Monitoring Well Location

80 0 80 160 Feet

Notes:

1. Base plan provided by Delphi Corporation.
2. Proposed well locations are approximate. Actual locations will be determined in the field based on access and local conditions.

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DELPHI CORPORATION
PLANT 400/DORT HIGHWAY
FLINT, MICHIGAN

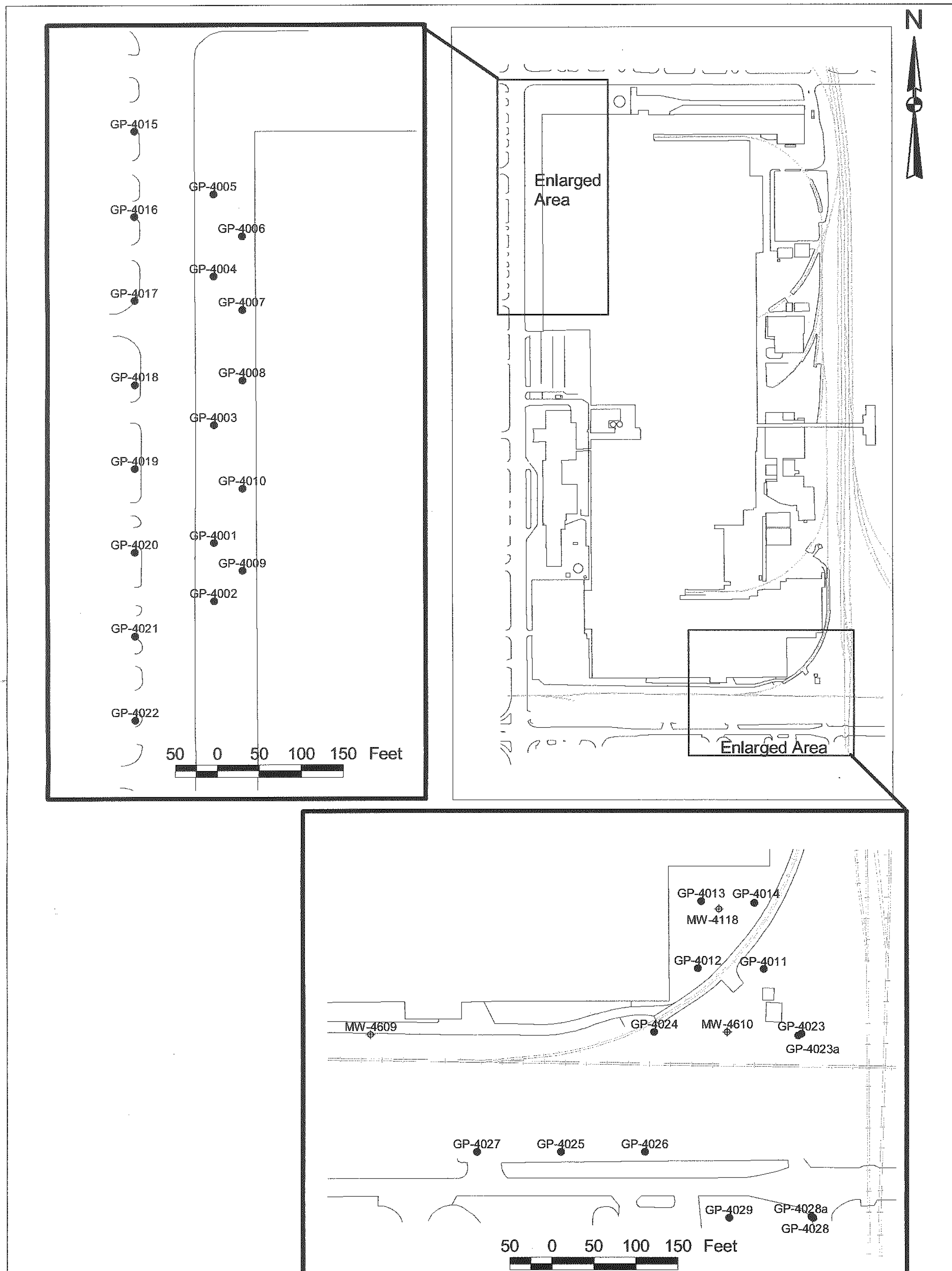
MONITORING WELL CLUSTER LOCATIONS

SCALE: AS SHOWN

MARCH 2003

FIGURE 5

rfi_wp_figures1.apr



Legend:

- Geoprobe Sampling Location
- Monitoring Well Location

Notes:

1. Base plan provided by Delphi Corporation.
2. Sample locations are approximate.

HALEY & ALDRICH

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

DELPHI CORPORATION
PLANT 400/DORT HIGHWAY
FLINT, MICHIGAN

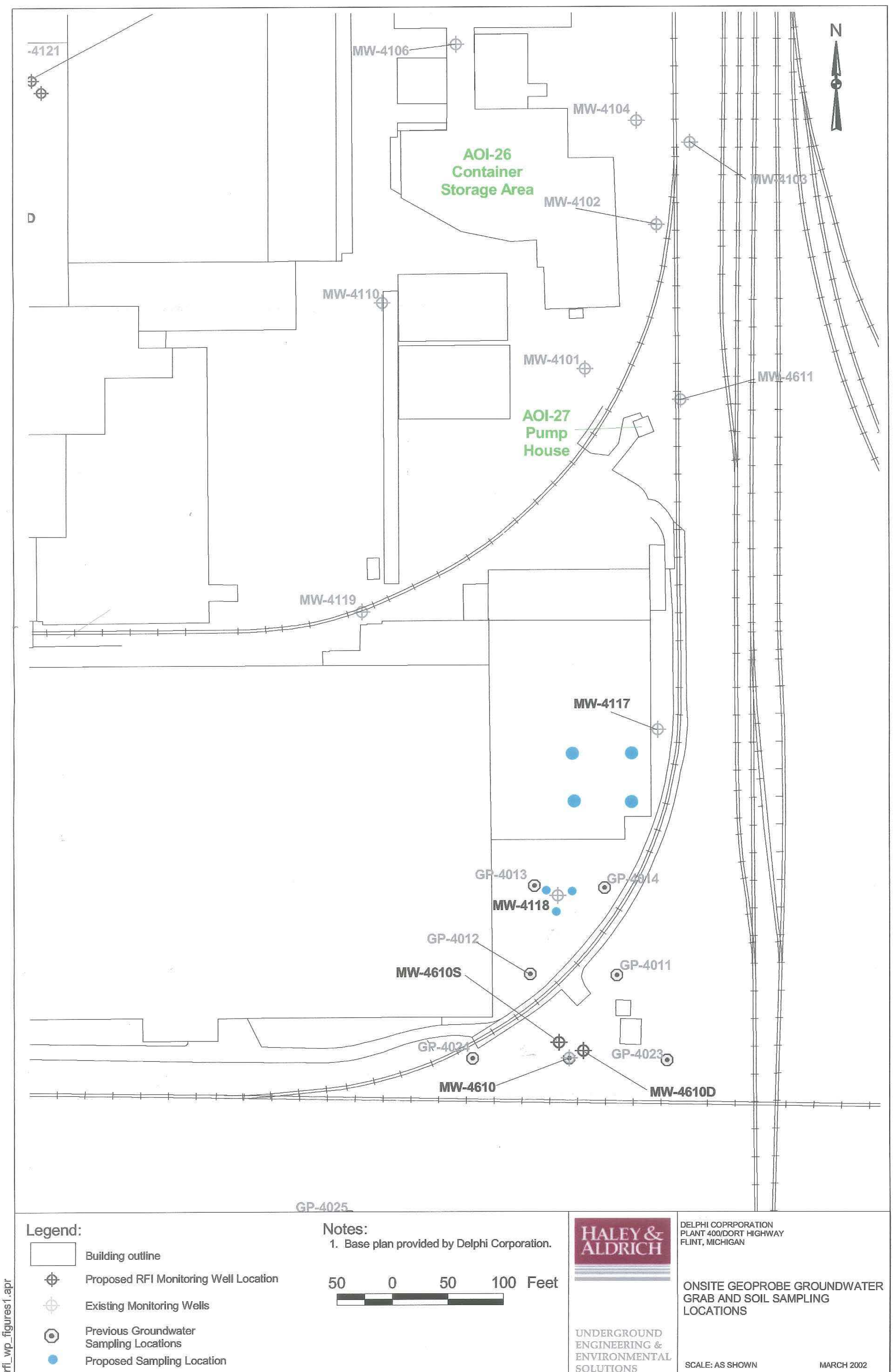
GEOPROBE GROUNDWATER GRAB SAMPLING LOCATIONS

SCALE: AS SHOWN

FEBRUARY 2002

FIGURE 6

G:\49017\001\DOCC\Final_Draft\FigureN.apr



N
-4121
D
MW-4106
MW-4104
MW-4103
AOI-26
Container
Storage Area
MW-4102
MW-4110
MW-4101
MW-4611
AOI-27
Pump
House
MW-4119
MW-4117
GP-4013
GP-4014
MW-4118
GP-4012
GP-4011
MW-4610S
GP-4024
GP-4023
MW-4610
MW-4610D
GP-4025
Legend:
Building outline
Proposed RFI Monitoring Well Location
Existing Monitoring Wells
Previous Groundwater Sampling Locations
Proposed Sampling Location
Notes:
1. Base plan provided by Delphi Corporation.
50 0 50 100 Feet
HALEY & ALDRICH
UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS
DELPHI COPRPORATION
PLANT 400/DORT HIGHWAY
FLINT, MICHIGAN
ONSITE GEOPROBE GROUNDWATER GRAB AND SOIL SAMPLING LOCATIONS
SCALE: AS SHOWN
MARCH 2002
rfi_wp_figures1.apr

FIGURE 7

PROJECT MANAGEMENT PLAN

DELPHI CORPORATION
DELPHI ENERGY & CHASSIS SYSTEMS
PLANT 400
1300 NORTH DORT HIGHWAY

FLINT, MICHIGAN

US EPA ID # MID 005 356 647

by

Haley & Aldrich, Inc.
Cleveland, Ohio

for

Delphi Corporation
Troy, Michigan

March 2003
File No. 49017-007

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

I. INTRODUCTION

This Project Management Plan (PMP) has been prepared as an attachment to and forms part of the RCRA Facility Investigation (RFI) Work Plan submitted by Delphi Corporation for the Dort Plant 400 Site.

This part of the RFI Work Plan presents the project management approach for the RFI to be undertaken at the Site. Project management for the RFI includes:

- Selecting, coordinating and scheduling staff, contractors, subcontractors and laboratories;
- Overseeing project implementation to ensure that technical requirements are met;
- Ensuring that work proceeds along the schedules, practices and standards set forth in the Work Plan; and
- Correcting any deviations from the Work Plan or schedule.

The purpose of the PMP is to present a discussion of the schedules, project organization, responsibilities and personnel including qualifications of personnel performing or directing the RFI.

II. TECHNICAL APPROACH

The overall approach which will be used for the RFI will be to collect and evaluate the data which are necessary to complete the RFI and to allow for the evaluation of corrective measures (if required). This approach will consider the fact that the Site is currently an operating industrial facility. As discussed in the Data Management Plan (DMP), Haley & Aldrich will be responsible for all aspects of data management. The goal of completing the RFI Report will be achieved by implementing the approved RFI Work Plan.

III. SCHEDULES

The schedule for the implementation of the RFI is shown on Figure 8 of the RFI Work Plan. It is the role of the Project Management Team, identified in Figure 1, to ensure that the schedules are met, or to identify the reasons why scheduled activities were modified.

IV. PROJECT ORGANIZATION AND RESPONSIBILITIES

Figure 1 presents the overall project management organization for the RFI.

The Project Manager for the U.S. EPA is:

Ms. Patricia J. Polston
United States Environmental Protection Agency
Waste, Pesticides, and Toxics Division
77 W. Jackson Boulevard, DW-8J
Chicago, Illinois 60604
Phone: 312.886.8093
Fax: 312.353.4788

The Project Manager for Delphi is:

Mr. Tim J. Renner, P.E.
Delphi Energy & Engine Management Systems
2900 Scatterfield Road
Plant 18
Anderson, Indiana 46013
Phone: 765-646-3292
Fax: 765-646-2829

All communication between U.S. EPA and Delphi, and all documents, plans, reports, approvals, and other correspondence concerning activities performed during the RFI, will be directed through the U.S. EPA and Mr. Renner.

The RFI effort will be implemented by an overall contractor and multiple subcontractors, each with a particular area of expertise necessary to successfully implement portions of the RFI. Qualified personnel will be designated to the corresponding tasks discussed below. Delphi or Haley & Aldrich may wish to change selected personnel in the future, and any such changes will be documented in progress reports. In the event of a change of consultants, contractors, subcontractors, etc., Delphi will notify the U.S. EPA prior to such a change.

Haley & Aldrich, Inc. (Haley & Aldrich) has been designated as Delphi's consultant for the project. Haley & Aldrich has prepared the Current Conditions Report and the RFI Work Plan. Haley & Aldrich will be responsible for the overall implementation and direct oversight of the RFI Work Plan and subsequent Work Plans and Reports. Haley & Aldrich's Project Director is David Hagen. Haley & Aldrich's Project Manager is Lloyd Ross. Haley & Aldrich's Project Coordinator is Ban Shamoon. Haley & Aldrich's Field Coordinator is Greg Liedel. Haley & Aldrich's Quality Assurance (QA) Officer is Denis Conley. Haley & Aldrich,'s Field QA Officer is Shawn Fiore. Haley & Aldrich's Health and Safety Officer is

Chris Merrifield. Haley & Aldrich's Field Geologist is Frank Palatka. ENVIRON has been designated as Delphi's human health risk assessor for the project.

The drilling subcontractor and analytical laboratory will be determined following competitive bidding protocols. The firm selected by Delphi for these activities will be identified to the U.S. EPA prior to commencement of field activities.

All firms will provide project management as appropriate to their responsibilities. Haley & Aldrich will provide subcontractor administrative oversight.

V. HALEY & ALDRICH QUALIFICATIONS

Haley & Aldrich is qualified to conduct all of the required professional services associated with the RFI at the Site. Haley & Aldrich has extensive experience in conducting investigations at RCRA and Superfund sites in the United States. In addition, Haley & Aldrich has prepared corrective action plans and implemented various phases of corrective actions at a variety of sites throughout the United States.

5.1 Key Personnel

As identified in Section 4, Haley & Aldrich has assembled a project management team and technical resource personnel with the necessary experience and capabilities required for this project. The project management team will consist of Mr. David Hagen who will be supported by the technical resource personnel as required. Brief descriptions of all personnel roles and qualifications are listed below, and curricula vitae are included in Appendix A.

5.2 Project Management

Mr. David Hagen: Mr. Hagen will act as Project Director. He will oversee all aspects of the project, participate in technical meetings with the U.S. EPA, and will be actively involved in the direction of the project. Mr. Hagen has extensive experience in projects of this nature. He will ensure that technical quality and scheduling are maintained throughout all activities.

5.3 Technical Resource Personnel

The following is a list of technical resource personnel who will assist with specialized aspects of the program.

Project Manager: Mr. Lloyd Ross, a Senior Scientist with Haley & Aldrich, will manage the implementation of the RFI Work Plan and evaluate data pertaining to the RFI. Mr. Ross works out of Haley & Aldrich's office located in Cleveland, Ohio.

Quality Assurance (QA) Officer: Mr. Denis Conley will act as Haley & Aldrich's QA officer for the project and will be responsible for overseeing laboratory activities, analytical data assessment and validation, and deciding laboratory data corrective actions, if required. Mr. Conley is located in Haley & Aldrich's Rochester, New York office.

Field Quality Assurance (QA) Officer: Mr. Shawn Fiore will act as Haley & Aldrich's Field QA officer for the project and will be responsible for the overall operation of the field team and reports directly to the Project Director and Delphi Project Manager. The Field QA Officer works with the project Health & Safety Officer to conduct operations in compliance with the project Health & Safety Plan. Mr. Fiore is located in Haley & Aldrich's Cleveland, Ohio office.

Health and Safety Officer: Mr. Christopher Merrifield will be Haley & Aldrich's Site Health and Safety Officer. Mr. Christopher Merrifield will supervise the Haley & Aldrich Site Health and Safety Representative (responsibilities defined in Health and Safety Plan), will provide managerial guidance with respect to Haley & Aldrich Health and Safety, and will participate in and/or review field decisions regarding Haley & Aldrich Health and Safety. Mr. Merrifield is located in Haley & Aldrich's Detroit, Michigan office.

Project Coordinator: Ms. Ban Shamoon will be Haley & Aldrich's Site Project Coordinator. Ms. Shamoon will oversee the field implementation of the RFI Work Plan and will be responsible for conformance of the work with the RFI Work Plan. Ms. Shamoon works out of Haley & Aldrich's office located in Detroit, Michigan.

Field Coordinator: Mr. Greg Liedel will be Haley & Aldrich's Field Coordinator. Mr Liedel will assist Mr. Ross and Ms. Shamoon with the field implementation of the RFI Work Plan and will be responsible for conformance with the RFI Work Plan. Mr. Liedel works out of Haley & Aldrich's office located in Detroit, Michigan.

VI. ENVIRON QUALIFICATIONS

ENVIRON will be the human health risk assessor for the project. ENVIRON is fully qualified to conduct risk assessments in accordance with U.S. EPA requirements for this project. ENVIRON's qualifications are presented in Appendix B. Dr. Stephen Song of ENVIRON will have principal responsibility for conducting the human health risk assessment for this RFI program. Dr. Song has over 15 years of experience in the use of risk assessment for investigation and remediation of hazardous waste under both RCRA and CERCLA. Dr. Song will be assisted by Ms. Kim Cizerle, who will manage the implementation of risk assessment activities. Ms. Cizerle has over 12 years of experience in conducting investigations and remediation planning for hazardous waste sites. ENVIRON will advise on work necessary to support the risk assessment (e.g., scoping the field investigation), and on the use of the risk assessment results (e.g., development of remedial action objectives). ENVIRON will provide the input and advise the Delphi project manager and Haley & Aldrich project manager on matters concerning human health risk at the Site.

VII. LABORATORY AND DRILLING SUBCONTRACTOR QUALIFICATIONS

The analytical laboratory subcontractor will be required to meet the following qualifications:

The subcontract laboratory will hold current National Environmental Laboratory Accreditation Conference (NELAC) certificates for analysis of solid and hazardous waste, drinking water and non-potable water using analytical methods promulgated by the United States Environmental Protection Agency (USEPA), and approved by the State of Michigan Department of Environmental Quality (MDEQ).

The subcontract laboratory will maintain certification through acceptable performance evaluations (PE) of environmental matrices analyzed using methodologies prescribed by:

USEPA "Test Methods for Evaluating Solid Waste, SW-846, Update III, 1996,

"Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," EPA-600/4-82-057, July 1982, EMSL Cincinnati, Ohio 45268,

and if applicable,

"Standard Methods For The Examination Of Water And Wastewater," 19th edition, American Public Health Association, 1995.

The drilling subcontractor will be required to meet the following qualifications:

1) Registered within the State of Michigan;
2) Satisfy applicable OSHA health and safety training requirements;
3) Provide suitable equipment and manpower to perform drilling activities within specified timeframes; and
4) Demonstrate previous experience relating to similar drilling programs.

The drilling subcontractor will provide a qualifications package, as required.

VIII. OTHER CONTRACTORS/SUBCONTRACTORS

The qualifications of all contractors, subcontractors, and their personnel used in carrying out the RFI Work Plan will be documented and provided to the U.S. EPA, as required.

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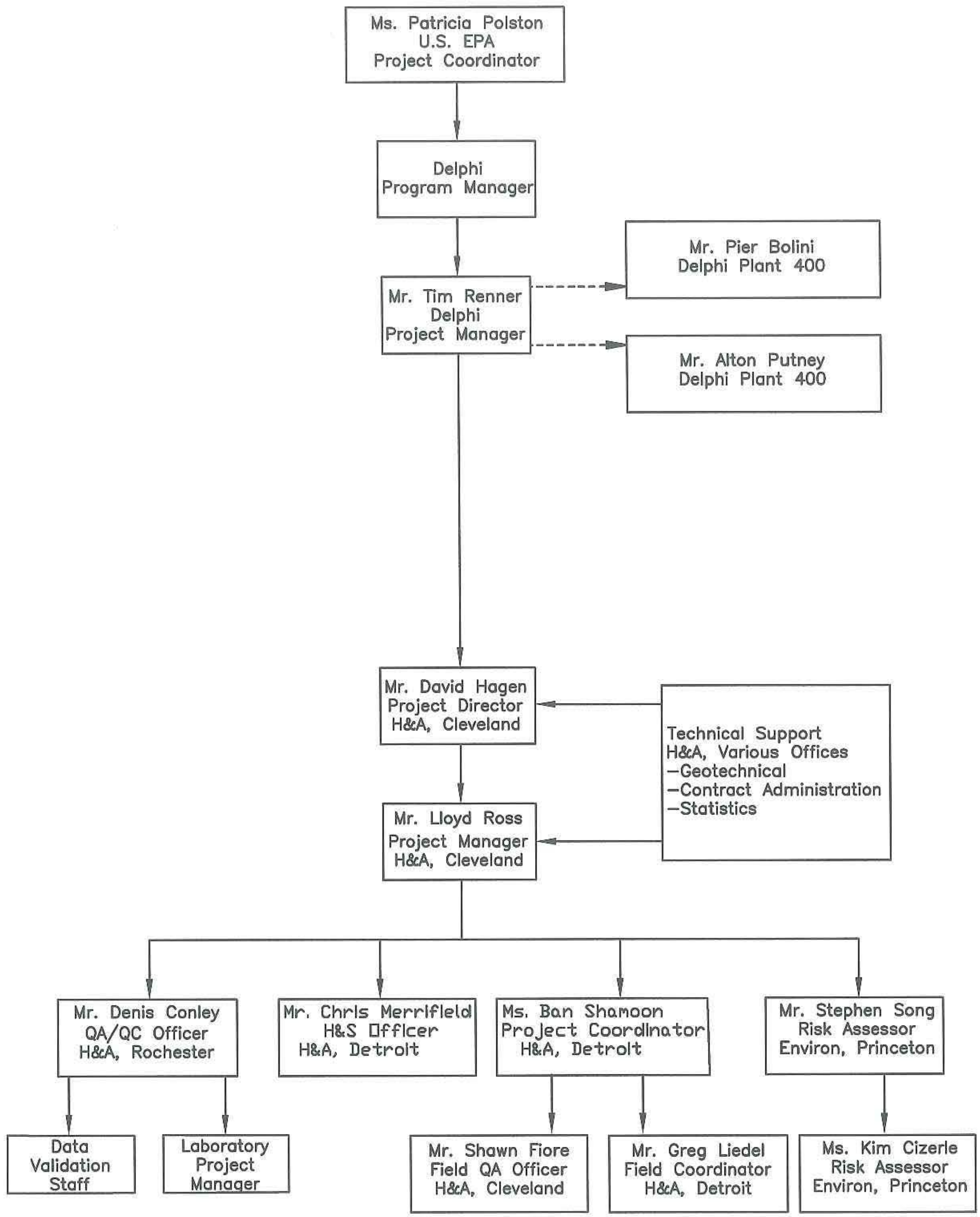

HALEY & ALDRICH

DELPHI CORPORATION
PLANT 400 – 1300 DORT HIGHWAY
FLINT, MICHIGAN

ORGANIZATION CHART

MARCH 2003

FIGURE 1

G:\48017\007\Project_Management_Plan\organizational_chart.dwg

APPENDIX A

Curricula Vitae

DAVID J. HAGEN, CP, CPG
Vice President/Senior Hydrogeologist

Summary of Qualifications

Since joining Haley & Aldrich in 1986, Mr. Hagen has participated in a variety of environmental investigations involving the delineation and remediation of soil and groundwater contamination. Project experience and responsibilities includes design and implementation of investigation programs, remedial design, remedial construction, landfill siting, RCRA closures, RCRA equivalency demonstrations, brownfield investigations and redevelopment, and hydrogeologic investigations. Responsible for development of site investigation programs, subsurface environmental testing, installation of monitoring systems, groundwater modeling, project management, remedial design, remedial construction management, regulatory compliance, and negotiations with regulatory agencies.

Relevant Experience

Project Remedial Investigations/Feasibility Studies. Project Manager for RI/FS's to delineate soil, groundwater and LNAPL/DNAPL contamination in a variety of hydrogeologic/geologic settings in numerous states. Scope of work on projects generally includes preparation of Quality Assurance Project Plans (QAPPs), work plans, sampling and analysis plans, negotiation with state/federal regulatory agencies, implementation of subsurface testing programs including the installation of monitoring wells with innovations such as telescoped casings to isolate contaminant zones, drilling of angled borings to evaluate vertical geologic structures, performing hydraulic testing including water pressure and slug testing, and implementing soil and groundwater quality sampling programs. The projects often involve a multi-disciplinary approach including risk assessment, environmental assessment and engineering feasibility studies.

Multi-Investigation Environmental Program. Program director for several remedial investigations being undertaken at a five-square mile industrial facility. Scope of work includes strategic planning development, technical guidance in conjunction with a peer review team, program development including preparation of work plans, field investigations and report preparation, negotiations with applicable regulatory agencies, and implementation of interim remedial measures. The project work consists of characterization and remediation of DNAPL in a fractured bedrock system.

Construction-Related Environmental Projects. Project Manager for numerous construction-related environmental projects. The projects included remediation of chlorinated solvent contamination beneath existing structures/buildings using innovative technologies such as dual-phase vacuum extraction. A similar project included the remediation of hydrocarbon-contaminated soils using innovative field testing and excavation methods to site remediation prior to a process change-overs at an automotive facility. Another project involved detailed characterization of a state superfund site that was undergoing building expansion. The site characterization delineated the nature and extent of contamination, provided estimates of soil volumes for disposal and determination of proper disposal methods.

DAVID J. HAGEN, CP, CPG
Vice President/Senior Hydrogeologist

Landfill Related Experience. Project manager and project hydrogeologist for hydrogeologic studies performed to support state landfill permitting. Project duties included development of site hydrogeologic investigation work plans, installation of monitoring wells, development of groundwater monitoring networks, evaluation of hydrogeologic and groundwater quality conditions, design of detection and assessment monitoring systems, statistical analysis of groundwater quality data for detection and assessment monitoring, financial assurance cost estimating and assistance with permit applications.

General Motors Corporation, Manufacturing Facilities. Project Manager for Phase I, Phase II, Phase III and Compliance Audits performed to support the sale of six manufacturing facilities in Michigan, Ohio and New York. Scope of work included Phase I, II and III investigations, compliance audits and support of property transaction negotiations between GM and prospective buyers. Responsible for the preparation and implementation Sampling and Analysis Plans, Phase I Investigations, Compliance Audits and Phase II Investigations. The Phase II investigations consisted of soil boring and monitoring well installation, sampling and analyses of impacted media and data QA/QC at large (greater than 1 million square feet) facilities.

Water Supply Experience. Project hydrogeologist and manager for numerous groundwater supply and development projects ranging from small-scale irrigation supplies to a 3 MGD groundwater supply development in a fractured limestone aquifer. Responsibilities have included local and regional hydrogeologic assessments, groundwater flow modeling, well installations (large diameter wells, deep installations, open-rock holes), well design and bid specification preparation, contracting, aquifer/pump testing, aquifer test analysis, capture zone delineation, and report preparation. Projects have been conducted in varied hydrogeologic settings including fractured limestones, sandstones and shales, glacial outwash, and alluvial fan deposits.

Remedial Design and Construction

Project Officer for numerous remedial design and remedial construction projects. Design activities included preparation of conceptual, preliminary, pre-final and final design packages, preparation of design specifications, preparation of remedial design cost estimates, preparation of construction schedules, preparation of contractor bid packages, evaluation of bids and contractor selection. Design projects have included remediation of a 60-acre former oil refinery by capping with geomembrane and installation of a groundwater collection trench, design of a vacuum-enhanced extraction system for DNAPL recovery, and design a vacuum extraction and groundwater migration control system at an active manufacturing facility. The latter project included design of a vacuum extraction system over a two acre area that consisted of the installation of 90 extraction wells, 180 air injection wells, capping of the site with a Bentomat cover and installation of a vacuum system capable of producing approximately 2000 scfm air flow. Extracted air was treated with a activated carbon that included conditioning of the air stream to control temperature and humidity. The remedial design also included a groundwater migration control system consisting of five wells capable of producing flows in the 400 to 600 gpm range. Groundwater is treated by air stripping with a carbon polish. Design activities on the project included securing appropriate air and water

permits. Each of the above projects included construction management services including field engineering, review of as-built drawings, review and approval of change orders, quality assurance testing/engineering and inspection of completed construction.

Education

Baldwin-Wallace College, Berea, OH, B.S. Biology, 1981
Oklahoma State University, Stillwater, OK, M.S. Geology

Certifications and Registration

Certified Professional - Ohio Voluntary Action Program
Certified Professional Geologist - American Institute of Professional Geologists
Registered Geologist - Pennsylvania

Professional Societies

Geological Society of America Association of Groundwater Scientists and Engineers
American Institute of Professional Geologists

Honorary Societies and Awards

Recipient of the Skinner Award in Geology, Oklahoma State University, 1986
Harl Aldrich Award

Special Studies and Courses

Brownfields Redevelopment, International Business Communications, July 1996

Theoretical and Practical Considerations of Flow in Fractured Rocks, Seminar Series with Shlomo P. Neuman

The Voluntary Action Program Process, Ohio Environmental Protection Agency, April 1997.

DNAPLs in Fractured Geologic Media: Behavior, Monitoring and Remediation, University Consortium Solvents in Groundwater Research Program, November 1997.

Groundwater Issues and the Ohio Voluntary Action Program, Ohio Environmental Protection Agency, June 1998.

DAVID J. HAGEN, CP, CPG
Vice President/Senior Hydrogeologist

Publications, Papers and Presentations

"Spatial and Temporal Variability of Groundwater Quality in a Shallow Aquifer in North-Central Oklahoma", discusses the spatial and temporal variability of nitrate concentrations in a shallow water aquifer. Unpublished M.S. Thesis, Oklahoma State University, 1986.

"Expecting the Unexpected", with A.W. Hounslow, W.A. Pettyjohn and R. Ross, Proceedings from the Sixth National Symposium and Exposition on Aquifer Restoration and Groundwater Monitoring, National Water Well Association, 1986.

DNAPL Determination Using Geoprobe Drilling, X-Ray Flouresence, and Dye Shake Testing and Subsequent Application in DNAPL Remediation, with R. Hare and D. Putz, Proceedings from the National Conference on Industrial Waste Water Treatment, Water Environment Federation, March 1997.

"Risk-Based Closure of a BUSTR Site", presentation to the Cleveland Engineering Society, November 1996.

Phase I and II Investigations, The Ohio Voluntary Program, presentation with Jones Day Reavis and Poque to Selected Industrial Corporations in Cleveland, September 1996.

"VAP Start-up and Debugging", Hagen, D., Presentation to the Cleveland Bar Association, July 1998

"DNAPL Determination and Recovery System Design", Hagen D., with Robert Hare, Presentation to the Cleveland Engineering Society, November 1998.

"Voluntary Action Program in Practice", Hagen, D., Presentation to the Cleveland Bar Association, February , 1999

DJH-gen/1292

LLOYD S. ROSS
Environmental Scientist

Since returning to Haley & Aldrich, Mr. Ross has done work on projects such as human health risk assessments, 3-dimensional site visualization modeling, data analysis and management, and environmental sampling.

Mr. Ross has performed multiple human and ecological risk assessments in accordance with guidance from U.S. Environmental Protection Agency, New York Department of Environmental Conservation, Massachusetts Department of Environmental Protection, and Alaska Department of Environmental Conservation. Mr. Ross has strong statistical and computer skills demonstrated in a variety of projects including 3-dimensional quantitative site models. Mr. Ross has also utilized Monte Carlo techniques to analyze for uncertainty associated with chemical and radiological Human Health Risk-based Preliminary Remedial Goals, generated statistical approaches for remedial certification and excavation sampling programs, and developed human health risk assessment software.

Relevant Project Experience

Geographic Information Systems. Scientist responsible for the database management and GIS production of figures for former chrome plating facility. Utilizing ArcView with additional scripting in ArcAvenue, figures were developed showing timeline progression of extent of soil and groundwater contamination and attenuation.

3-Dimensional Environmental Site Visualization. Scientist responsible for developing quantitative animated 3-dimensional models for several industrial sites. Modeling included the use of 3-dimensional geostatistical methods to develop animated presentations showing the relationship among regional geology, hydrogeology, site features, extent of product, and the co-mingling contaminant plumes.

Human Health Risk Assessment Software. Designer and computer programmer responsible for the development of a proprietary cross-platform computer software application to calculate site specific human health risk assessments for multiple exposure scenarios and to manage the chemical and radiological databases associated with human health risk assessments.

Gilson Road Human and Ecological Risk Assessment, New Hampshire. Ecological Risk Assessor responsible for designing, performing and writing ecological risk assessment for CERCLA-listed site. Ecological risk assessment included macroinvertebrate survey and analysis, bioassay testing, and benchmark study. In addition, generated human-health risk assessment calculations and human health-based monitoring levels for surface water. Collected ambient air and soil gas samples to determine potential exposure pathways and exposure point concentrations.

Estuarine Ecological Risk Assessment, Massachusetts. Ecological Risk Assessor responsible for the ecological benchmark risk assessment for petroleum contaminated site located within an estuary and wetland area listed as a Massachusetts Area of Critical Environmental Concern.

LLOYD S. ROSS
Environmental Scientist

Frequency of Chironomid Deformities in Cleveland Harbor and Near-Shore Zone of Lake Erie. Ohio. Scientist responsible for the evaluation of the frequency of midge larvae (Chironomidae) mouthpart deformities and the relationship of deformity frequency to sediment cation concentrations. Evaluated the chronic effects of cadmium and chromium to midge larvae deformities, growth, and survival.

Indiana Bat Habitat Survey, Ohio. Scientist responsible for the design, performance, and writing of a field evaluation of Indiana Bat habitat (an Ohio-listed endangered animal). Generated written report summarizing habitat quality and recommendations for improvement and restoration of potential habitat after completion of soil remediation project.

Electro-Fishing Survey, Great Miami River, Ohio. Scientist responsible for the annual electrofishing survey of the Great Miami River. Responsibilities included the collection of fish using boat-based electrofishing equipment, identification of fish species, harvesting of tissue for uranium analysis, and writing summary of fish survey results analyzing community structure, growth rates, and other stress indicators among the various collection stations.

Cleanup Levels for Petroleum Products, Alaska. Risk Assessor responsible for the development of site-specific cleanup levels for various sites in Alaska. Site specific information was utilized to modify fate and transport models and exposure scenarios to develop human health based cleanup levels.

Cleanup Levels for Former Manufactured Gas Plant, New York. Risk Assessor responsible for the development of site-specific cleanup levels for former manufactured gas plant. Site specific information was utilized to modify fate and transport models and exposure scenarios to develop cleanup levels.

Time-Line Reduction in Human Health Risk, Ohio. Scientist responsible for the generating the reduction in Human health risk estimates based on various remediation schedules and achievement of remediation goals. Time-lines generated were used in successfully receiving congressional funding for accelerated remediation schedule.

Monte Carlo Uncertainty Analysis of Preliminary Remediation Goals, Ohio. Scientist responsible for utilizing Monte Carlo technique in analyzing uncertainty associated with exposure parameters and toxicity assessment used in the development of Preliminary Remedial Goals.. Compared Monte Carlo derived distributions to traditionally (determinate) derived preliminary remediation goals for multiple receptors and exposure scenarios.

Education

Heidelberg College, Tiffin, OH, B.S. Biological Science, 1990.

University of Cincinnati, Cincinnati, OH. M.S. Ecology/Evolution, 1995

Kent State University, Kent, OH. Post-graduate studies. Ecology, 1998.

DENIS M. CONLEY
Senior Project Manager/Scientist

Summary of Qualifications

Mr. Conley serves as a Senior Project Manager within the Remediation Technology Group at Haley & Aldrich's Rochester, NY office. He has more than 15 years of diversified experience in the evaluation, deployment, and operation of numerous remediation technologies including enhanced bioremediation, soil vapor extraction, 2-PHASE extraction, radio frequency heating, and In-situ Thermal Desorption (ISTD). Mr. Conley has conducted and managed projects throughout the continental US, Western Europe, Great Britain, the Mediterranean Coast, and in the South Pacific. Denis' clients have included Fortune 50 industries, federal agencies, and international environmental ministries. Projects have ranged from innovative technology evaluations conducted for State and Federal Agencies to full-scale implementation of remedial technologies under Voluntary Action Programs (VAPs), Superfund remedial actions and emergency response orders for industrial and public agency clients. Mr. Conley has expertise in the remediation and/or decontamination of structures, surface and subsurface soils and groundwater impacted with polychlorinated biphenyls (PCBs), dioxins/furans, spent chlorinated solvents, herbicides and pesticides, and hazardous petroleum distillates.

Mr. Conley has served as adjunct faculty with the Rochester Institute of Technology's (RIT) Department of Environmental Management in Rochester, New York conducting lecture and laboratory courses in environmental chemistry and microbiology for undergraduate, graduate, and continuing education students.

Relevant Project Experience

In Situ Thermal Desorption (ISTD) Technology Evaluations, Numerous Sites, Continental US and Canada. Mr. Conley has been retained to evaluate the feasibility of application of the patented Thermal Well technology at numerous sites throughout the US and Canada. These services have been provided to public and private sector clients. Typical evaluations include bench scale thermal treatability testing of site materials and the development of full-scale implementation strategies for this unique and robust remediation technology.

Former Hazardous Waste Disposal Site, Commercial Client, Sulphur, LA. Project Manager of a multi-year remedial program at a former hazardous waste impoundment in southwestern Louisiana. Tasks include the development of a Groundwater Management Plan for numerous areas of investigation, evaluation of intrinsic bioremediation mechanisms, and development of a risk based corrective action strategy under current and proposed State of Louisiana regulations.

Conoco, Inc., Lake Charles, LA. Project Scientist for the installation and shakedown of a groundwater pump-and-treat system for the recovery of ethylene dichloride (EDC) as free phase product for re-use at an active industrial facility in Lake Charles, Louisiana. The recovery system utilizes carbonaceous and polymeric resins to adsorb EDC. Free phase is

recovered through regeneration using plant steam. Mr. Conley performed proof of concept testing with a pre-designed pilot unit and assisted in the design of the full scale system. Shakedown of the full-scale system was completed in less than six (6) weeks with the assistance of on-site analytical services.

In Situ Thermal Desorption (ISTD) Technology Development. Mr. Conley served as the Corporate Quality Assurance Officer for TerraTherm Environmental Services, Inc. during the implementation of the ISTD process at sites throughout the US and South Pacific. Contaminants successfully treated by ISTD "in-situ" included chlorinated solvents, heavy diesel fuel, PCBs, and dioxins/furans.

Facility Decontamination & Restoration, Israel Electric Corporation, Ashdod, Israel. Mr. Conley provided Quality Assurance oversight for insurance representatives during the facility decontamination and restoration following a PCB transformer fire. The facility was a 200,000-sq. ft. electric power generation station located on the coast of the Mediterranean Sea. Decontamination was performed in accordance with protocols established by the USEPA Office of Pollution Prevention and Toxics and promulgated under 40 CFR Part 761.

Missouri Electric Works, Cape Girardeau, Missouri. Mr. Conley served as the project scientist responsible for providing quality assurance/quality control services, data validation, and oversight of stack testing programs at a National Priority Listing (NPL) site. Demonstration Testing was conducted using the TerraTherm In-Situ Thermal Desorption (ISTD) process for remediation of PCBs from overburden soils without the need of excavation.

General Motors Corporation Facilities, Hydrogeologic Investigations, Continental US and Mexico. Mr. Conley prepared SAPs, QAPjPs, and assisted in the implementation of work plans developed with GM-Environmental Systems and Services staff, at former Delco Division facilities. Mr. Conley also prepared detailed Data Validation Reports addressing useability of the analytical data in representing the environmental conditions at each facility.

Xerox Corporation, Numerous Sites, Continental U.S. & Europe. Mr. Conley provides technical oversight and management of on-site analysis in support of in-situ remediation of soils and groundwater using the patented 2-PHASE Extraction technology. The on-site analyses include aqueous and vapor sample collection and quantification of organic contaminants. The data is utilized to optimize the rate of removal of subsurface contaminants.

Eastman Kodak Company, Facility Reference Document, Rochester, New York. Mr. Conley developed a site wide Quality Assurance Project Plan for the Kodak Park facility. The QAPjP is utilized as a guidance document for preparation of environmental sampling and analysis work plans conducted at the facility. The document encompasses each element required to achieve Data Quality Objectives (DQOs) for NYSDEC interim remedial measures (IRMs), RCRA Facility Investigations (RFI), and CERCLA Remedial Investigations/Feasibility Studies (RI/FS).

United Technologies Corporation, Remediation Pilot Study, Superfund Site, Central Maine. Mr. Conley performed an evaluation of analyses conducted in conjunction with a

precipitation/UV oxidation remediation system pilot study conducted at a federal Superfund Site.

British Petroleum America, Remediation System Audits, Western New York. Mr. Conley performed remediation system audits of soil and groundwater remediation systems installed at an operating manufacturing facility in western New York. The extraction and treatment system was evaluated to optimize the mass removal rates for the spent chlorinated solvents present in the combined bedrock and overburden aquifer, and overburden soils.

Superfund Innovative Technology Evaluation (SITE) Program Demonstration, New Bedford Harbor, Mass. A Super Critical Fluid Extraction (SCFE) process was evaluated for remedial effectiveness of extracted PCB's from estuarine and oceanic sediments dredged from New Bedford Harbor (EPA 540/G-90/007). Mr. Conley was responsible for the evaluation of the pre-treatment, post-treatment and process raffinate analyses.

Education

University of Southern Maine, Portland, Maine
B.A. Biology
University of Southern Maine, Portland, Maine
B.S. Applied Chemistry

Certification

State of Maine, Certified Bacteriologist 1989
State of New York, Approved Data Validator
NYSDEC, Hazardous Waste Remediation Group, 1991

Additional Training

8 Hr. Refresher (29 CFR 1910.120), 1992-1999
OSHA 40 Hr. (29 CFR 1910.120), 1991
Comprehensive Industrial Hygiene (CIH), University of Michigan, 1995
Process Chemistry for Water Treatment, University of New Hampshire 1989

Recent Publications

Conley, Denis M., J. Savarese, S. Gupta, and R. Baker, 2002, "Field Demonstration of Thermally Enhanced Multi-phase Extraction", presented at the 3rd International Conference on the Remediation of Recalcitrant and Chlorinated Compounds, Battelle Memorial Institute, Monterey CA, May 23, 2002.

Conley, Denis M., 2000, "Field Scale Implementation of Thermal Well Technology, Naval Facility Centerville Beach, Ferndale, California", presented at the 2nd International Conference on the Remediation of Recalcitrant and Chlorinated Compounds, Battelle Memorial Institute, Monterey CA, May 22, 2000.

DENIS M. CONLEY

Conley, Denis M., K.S. Hansen, G.L. Stegemeier, "In Situ Thermal Desorption of Refined Petroleum Hydrocarbons from Saturated Soils" presented at the 2nd International Conference on the Remediation of Recalcitrant and Chlorinated Compounds, Battelle Memorial Institute, Monterey CA, May 22, 2000.

Baker, Ralph S., D. M. Conley, J. Galligan, D. Gregory, P. Patton, S. Hall, "ISTD Treatability Study at Rocky Mountain Arsenal Hex Pit", proceedings of the 2nd International Conference on the Remediation of Recalcitrant and Chlorinated Compounds, Battelle Memorial Institute, Monterey CA, May 22, 2000.

Conley, Denis M., 1999, "Application of ISTD Thermal Well Technology- Case Study", presented at the 1st International Environmental Exposition, Interstate Technology Regulatory Cooperation (ITRC) Workgroup, Atlantic City, NJ, April 21, 1999.

Hansen, Kirk S., D. M Conley, H. J. Vinegar, G. L Stegemeier, 1998, "In Situ Thermal Desorption of Coal Tar", proceedings from the 11th International Symposium, Institute of Gas Technology, Orlando, FL., December 6-9 1998.

Conley, Denis M., K. Jenkins, 1998, "Application of ISTD to Remediate PCBs from Soil at the Former Mare Island Naval Shipyard, Vallejo, CA.", presented at the 3rd Annual Tri-Service Conference, San Diego, CA., August 15-17, 1998.

Vinegar, Harold J., G. L Stegemeier, J. M Hirsch, D. M. Conley, et al, 1997, "In Situ Thermal Desorption of PCBs", proceedings of the Superfund XVIII Conference, Washington, DC, December 2, 1997.

Conley, Denis M., and J. E. Loney, 1996, "Applied Groundwater Treatment using UV Oxidation Technologies", presented at the 28th Mid-Atlantic Industrial and Hazardous Waste Conference, Buffalo, NY, July 14-17 1996.

Edwards, David A., D. M. Conley, and M. G. Biekirch, 1996, "Surfactant Applications in Environmental Restoration," proceedings of the 28th Mid-Atlantic Industrial and Hazardous Waste Conference, Buffalo, NY, July 14-17 1996.

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SHAWN S. FIORE, P.G., C.P.
Senior Environmental Geologist

Relevant Project Experience

ExxonMobil Projects

Former Refinery/Lubricating Oil Plant, Woodhaven, MI. Project manager overseeing the decontamination and removal of buried product/waste piping, the on-site management of 35,000 cu yds of excavated soils, completion of a hydrogeologic investigation of the site, management of on-site stormwater issues and pilot testing/remedial design for closure of oil sludge pond.

Wolverine Pipeline Spill Assessment Remediation, Jackson, MI. Provided key senior technical assistance for remedial investigation (RI) and preliminary remedy assessment activities in support of remediation efforts, completed under Michigan Part 201 Rules. Provided senior level support in the design of investigative activities focussed on three major areas of concern. Also provided senior technical review on abandonment/sampling of over 100 potable water wells and replacement of the wells with municipal water lines. Reviewed combined groundwater recovery/treatment, phytoremediation, and natural attenuation remedies for full containment of chemicals of concern.

Former Mobil Oil Corp., Lubricating Oil Facility, Cleveland, OH. Project manager and lead hydrogeologist for investigation and remedy assessment at Lubricating Oil bulking facility. Comprehensive site assessment indicated presence of highly viscous LNPAL beneath facility. Completed remedial evaluations for remedy of this condition, including groundwater recovery, skimming, biosplurping, steam injection, and vacuum enhanced total fluid recovery.

Niles Terminal, Niles, MI. Project manager and lead hydrogeologist for immediate response action related to release of diesel fuel caused by valve failure. Worked with local ExxonMobil personnel to move project from emergency response to continued response phase. Provided innovative solutions for treatment/disposal of recovered water / NAPL from spill response activities, saving ExxonMobil more than 75 percent of initial estimated costs. Prepared sampling and analysis work plans for post-spill assessment.

Former Muskegon Terminal, Muskegon, MI. Project manager and lead hydrogeologist for former terminal facility. Prepared strategy for obtaining State NFA status and worked with ExxonMobil to define steps toward achieving NFA.

Former Dearborn Terminal, Dearborn, MI. Prepared closure plan for facility, and achieved MDEQ and ERB approval for the plan. Worked with ExxonMobil and current owner to get owner's approval and sign-off on deed restrictions to obtain final closure.

Muskegon Dock Project, Muskegon, MI. Worked with ExxonMobil legal and technical staff to define response actions at a former railroad dock/barge line head. Reviewed

historical documents to define activities at the site and determine other corporations involved (formerly or presently) in the operation of the site. Worked with current owner to define investigation plan and obtain state approval of this plan to assess lake sediment, surface water, groundwater, and soils.

Wolverine Pipeline Site, Grand Haven, MI. Worked with Wolverine management and ExxonMobil technical staff to monitor site conditions, discuss activities with MDEQ personnel and define and sampling and analysis program to meet the MDEQ requirements and minimize site risk, without completing active groundwater remediation.

Former Mobil Oil Terminal, Newark, OH. Implemented remedy to minimize site risk and allow for closure and final sale of facility. Managed investigation and remedial alternatives, as well as some demolition activities completed prior to sale.

Former Mobil Oil Terminal, Cleveland, OH. Implemented remedy to minimize recovery of LNAPL and impacted groundwater at closed site, located along a major river. Managed underground storage tank removal program to allow for regulatory closure and sale of facility.

Other Project Experience

Cummins Engine Company, Nationwide. Program manager for environmental Assessment, compliance and operations assessment, remedial design, remedial closure and wastewater treatment facility upgrade operations at more than 35 facilities in 20 states. State closure (No Further Action) was achieved at majority of facilities, which ranged in size from small engine repair shops to > 1,000,000-sq-ft facilities.

Former Chemical Plant, Toledo, OH. Provided key senior technical support for remedial investigation and remedial design of former plastics manufacturing plant in Northwest Ohio. Evaluated phthalate NAPL plume and existing recovery system for effectiveness and efficiency, as well as for design optimization. Reviewed and assessed soils and groundwater, with respect to industrial/commercial development following Ohio Voluntary Action Program rules. Worked with client and developer to obtain "Rule 13 Permit" from the OEPA, to allow for commercial development of facility.

Union Carbide Corporation CERCLA Site, Marietta, OH. Provided key senior technical support for assessment and remedial design of soil and groundwater operable units at closed facility in Marietta, OH. Completed assessment of waste historic disposal areas and hydrogeologic and statistical review of groundwater management areas. Completed natural attenuation assessments, working with UCC Personnel, and USEPA and OEPA technical personnel, for inclusion of this more passive remedy to minimize the active groundwater recovery activities. Completed design/evaluation of groundwater recovery system for mitigation of chlorobenzene, benzene, and dioxin.

SHAWN S. FIORE, P.G., C.P.

Rickenbacker Air National Guard Base, Lockbourne / Columbus, OH. Hydrogeologic / contaminant assessment characterization for Air Force facility with 27 identified disposal/ release areas. Technical analyses included characterization of the complex local aquifer system, groundwater/surface water interaction, and the formulation of conceptual site models and additional assessment activities for pesticides, herbicides, PCBs, fuel components, metals, and chlorinated solvents in soils and groundwater. Assisted in negotiation of RI Phase II investigation activities with the USEPA and Ohio EPA.

CSL CERCLA Site, Elyria, OH. Provided senior technical review on former chemical solvents recovery facility on which, more than 5,000 drums of solvents had reportedly been stored. Assisted in support of preparation of scoping documents to assess site soil, groundwater, surface water, and sediment pathways prior to issuance of USEPA AOC and negotiation on scope with the USEPA.

Iowa Air National Guard Base, Sioux Gateway Airport, Sioux City, IA. Project manager and lead hydrogeologist overseeing complete investigation, remedial design, construction and operation and maintenance activities for impacted groundwater and soil, in buried valley aquifer system. Activities completed included site investigation, remedial investigation, feasibility study, remedial design, remedial action and operations, maintenance and monitoring. 'No Further Remedial Action Planned' decisions were achieved for two sites. Worked with client to achieve IDNR and USEPA approval of remedies.

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CHRISTOPHER L. MERRIFIELD
Corporate Health and Safety Manager
Senior Engineer

Summary of Qualifications

Mr. Merrifield is a Safety Engineer with 13 years of experience in a multitude of disciplines related to environmental, health and safety (EH&S) issues. Mr. Merrifield spent 5 years in the Petrochemical industry as a plant safety engineer prior to becoming a consultant. Mr. Merrifield's last 8 years as a consultant have included facilitating extensive health and safety training, EH&S systems/compliance audits, and other related disciplines such as indoor air quality, ISO 14000, asbestos, and industrial hygiene. Currently, Mr. Merrifield performs the role as Corporate Health and Safety Manager for Haley & Aldrich.

Relevant Project Experience

Process Safety Management

Elf Atochem - Process Safety Management. Participated in various size Hazard Operability Studies (Hazops) with a cross section of plant employees at the facility. All major Hazops were "facilitated" by an outside risk management vendor. The facility manufactured 10 different mercaptans ranging from relatively non-hazardous to extremely hazardous with the potential for catastrophic results. Acted as the Safety representative for most "Management of Change" assessments and "Preliminary Hazard Analysis" as ongoing responsibility to comply with the PSM standard.

Star Enterprise-Process Safety Management. Member of Star's- "Process Safety Management" team, which performed Hazard Operability Studies (Hazop's) for major plant facilities. Participated as a safety representative of the Hazop team and also reviewed "Management of Change" process changes for equipment that was installed after initial start-up. All Hazop's were facilitated internally and (Texaco-Star) was extremely proactive in their attempt to comply with the PSM standard.

Santa Fe Energy Resources – Health & Safety Audit. Comprehensive health & safety systems and compliance audit for Santa Fe Energy Resources based out of Lafayette, LA and Houston, TX. Initially audited the companies Houston and Lafayette offices for documentation, training, emergency response programs, and over-all health and safety program. Included auditing six to seven offshore platforms located offshore of Matagorda, Tx and Lafayette, LA in the Gulf of Mexico, one large oilfield (including all pumping stations) and one compressor station located in West Texas. Developed a written report in accordance with OSHA, USCG and MMS regulations. The American Petroleum Institute's (API) Recommended Practices for development of a Safety and Environmental Management Plan (SEMP) for OCS Operations and Facilities (RP75) audit protocols were used for the offshore processes. OSHA's, Process Safety Management standard was used for all onshore process reviews.

Industrial Emergency Response

Elf Atochem - Emergency Response. Member of plant Fire Brigade and Hazmat Incident Command Team. The plant makes extremely toxic and flammable mercaptans from raw hydrogen sulfide feed stocks. Developed and organized the emergency response team (ERT) program in accordance with OSHA and Channel Industry Mutual Aide requirements (CIMA). CIMA is the largest mutual aide provider in the world for emergency preparedness. Major project coordination with neighboring plants and community.

Emergency Response Training. Manager for environmental company with a long history with major companies in Texas in facilitating advanced emergency response training. Developed customized training needs for clients that request that training follow company protocol and procedures. Notable clients and training provided-**Texas Instrument, Motorola, Cypress Semiconductor, Hampshire Chemical, IBM, Ashland Chemical, Chevron Refinery-Port Arthur, Aristech, and City of Austin Electric Department** all 24 hour Hazmat Technician. **IBM, Devoe/Reynolds**-Confined Space training. **Evalca Chemical and Montgomery Tank Line** Incident Command Training.

Double Eagle Steel Company- Emergency Response Plan Development. Double Eagle Steel Company is engaged in the production of electrogalvanizing of sheet steel. Responsible for coordinating a team of employees to "rework" the companies written integrated emergency response plan. The plan complies to virtually every emergency response requirement that OSHA, DOT, EPA and state authorities require for the plant. The plan includes a field guide and guidance manual.

Procedure Development

Star Enterprise - Regulatory Compliance/ Procedure Development. Responsible for procedure development and implementation as required by 29CFR1910 and 29CFR1926 for one of the worlds largest oil refineries. Most notable projects were development of the plants lockout/tagout procedure and major revisions to the plant hot, safe and confined space work permit system which includes various safety practices such as trenching/shoring, hot-tapping, electrical, blinding, and bleeding as examples.

Star Enterprise - Regulatory Compliance. Responsible for leading and facilitating near miss, unusual happening, and accident investigations for all major incidents at the refinery. Prepared root cause analysis to major refinery incidents and implemented corrective actions. Provided 100's of hours of compliance auditing in regards to programs and operations for the facility.

Star Enterprise-Safety/Industrial Hygiene Audits. Audit Member of Safety Quality Action Team and **"OSHA Voluntary Protection Program" (VPP)** which assured compliance with union and OSHA in regards to safety and industrial hygiene. This generally entails comprehensive audits with OSHA members and union members on all design and operational requirements per OSHA and plant Sop's.

Elf Atochem - Regulatory Compliance/ Program Development . The Houston, Elf Atochem facility manufacturers a variety of mercaptans. Responsible for procedure development and implementation for 29CFR1910 and 29CFR1926 in the plant which made various mercaptans. Most notable procedure and program developments included lockout/tagout, bonding and grounding, Injury reporting, scaffolding, excavation program, and hot work permit. Monitored contractor safety program. Provided 100's of hours of compliance auditing in regards to programs and operations for the facility. All Programs and Procedures were written to ISO 9000 standards. This included re-formatting all existing procedures to meet the standard as well for certification.

Elf Atochem - Industrial Hygiene Program. Developed first stages of the IH program to meet OSHA and corporate requirements for basic industrial requirements monitoring requirements and noise survey. Monitored for hydrogen sulfide and mercaptan over-exposures during operational and maintenance activities.

National Broadcasting Corporation (NBC Chicago) - EHS Program Support. Developed the facilities site-specific fall protection, hearing protection, personal protective equipment, and hazard communication written programs, including all associated forms to comply with the OSHA standard. In conjunction with the development of the written programs, developed and conducted customized training for the four written programs to NBC employees.

Gund Arena/ Cleveland Cavaliers Corporation – OSHA & EPA Programs. Gund Arena is a world class event arena located in Cleveland, Ohio that host Professional Basketball and hockey events as well as other entertainment events. Developed comprehensive plans and procedures for crisis management, bloodborne pathogens, hazard communication, personal protective equipment, hazardous waste management, fall protection, and powered industrial vehicles. This included the development of extensive hazard assessment of all of the jobs that are performed at the arena.

General Motors – Standard Operating Procedure. Developed an Air Monitoring SOP for measuring and detecting particulate matter for the General Motors REALM group.

Training

USAA Insurance Foundation Group - Program/Training Development. Developed a confined space protocol and respirator program for USAA insurance foundation group in Dallas, Texas. This insurance group is responsible for inspecting under slab, which occasionally includes tunneling. Developed and facilitated a confined space entry-training program, which addressed air monitoring, entry procedures, PPE selection and ventilation.

ENSR Corporation/Fugro Environmental - Asbestos and Hazwoper Training Develop training courses and conduct these same courses for open enrollment asbestos and Hazwoper courses. Training courses for Southern region employees. Conducted classes for ENSR's South America offices allowing for a different insight on South American policies and challenges in regards to health and safety.

Texas Natural Resource Conservation Commission – Hazardous Waste Operations and Emergency Operations Training Facilitated initial and refresher training for an estimated 500 employees from the Texas Natural Resource Conservation Commission over a period of two years for the Austin, Houston, and Beaumont offices. Environmental Options, Inc. was the exclusive vendor for the TNRCC.

Archon Reality Group - Asbestos Program Development. Developed a 75 page, two hour asbestos awareness script for Archon Reality Group that was eventually used for the development of a two hour awareness video for all Archon Reality Group properties that have asbestos containing building materials. Script was developed to meet OSHA standards for asbestos awareness as well as include Archon Reality Group's specific operation and maintenance program requirements. This required a very intensive research and development on both asbestos and Archon's practices for working with and around asbestos.

Toyota Motor Sales - ISO 14001/Environmental Management Systems Training. Participation in facilitating training to Toyota Motor Sales employees in Massachusetts. Classes included implementation requirements and program assessment.

Gulfstream Aerospace Corporation- ISO 14001/Environmental Management Systems Training Involved in development and presentations outlining the requirements of Environmental Management

Systems and ISO 14001. Related the significance of each to the company's current needs in their South Carolina location.

MCI Corporate Environmental Health and Safety Group - Asbestos Training Developed an extensive CD-Rom Training Program for MCI Corporate Environmental Health and Safety Group that was performed via "satellite" around the country at their Career Enhancement University in Dallas. The two classes conducted were the 2-hour OSHA asbestos awareness class and 8 hour, MCI specific, manager/engineer training that was broadcast to over 25 locations simultaneously in the United States. The "Distance Learning" format allowed attendees to communicate among other students and myself.

Various Consultants, Malaysia - Safety/Environmental Management Systems Training. Developed and delivered two days of training to various consultants located throughout Asia to perform EH&S audits and Phase I assessments for a confidential client. Training focused on the proper auditing techniques and format for an Environmental, Health and Safety Audit. Training was conducted in Kuala Lumpur, Malaysia.

Loctite Corporation- Confined Space Entry Training. Developed and conducted a company specific confined space entry training course for service and sales employees located at the Loctite Corporation Headquarters in Rocky Hill, Connecticut. The employees are required to enter various spaces within their clients' facilities to repair and service Loctite installed equipment. Training was based on the company's internal procedures and the OSHA confined space standard. Training was a full day course and used various training media's.

New England Electric Wire Company - OSHA, EPA, & DOT Training. New England Electric Wire Company engineers and manufactures specialty wire for various industries around the world. NEEWC uses raw product to develop numerous types of braided wire. Developed and conducted Hazwoper First Responder Training, DOT- Hazmat employee training, and EPA – RCRA training for the facility over the course of one week at the New Hampshire facility.

Gund Arena/ Cleveland Cavaliers Corporation – OSHA & EPA Training. Gund Arena is a world class event arena located in Cleveland, Ohio that host Professional Basketball and hockey events as well as other entertainment events. Developed and conducted crisis management planning, bloodborne pathogens, hazard communication, personal protective equipment, hazardous waste management, fall protection, powered industrial vehicles to over 300 employees during the course of 8 training sessions. The training was a result of us developing the Gund Arena Environmental, Health, and Safety Programs for the Arena. This included the development of multiple plans and an extensive hazard assessment of all of the jobs that are performed at the arena.

Project Oversight

BOC Gases – Health and Safety Oversight for Large Decommissioning Project. Developed extensive health and safety procedures for BOC gases in Houston for cleanup and remediation activities in an abandoned Acetylene and MAPP gas production facility. Included asbestos abatement, extremely corroded and unstable cylinder palletizing, waste over-packing performed in level B protection, and remediation of a lime pond with pH levels as high as 12.5. Responsibilities included numerous days on site to coordinate the overall safety activities during de-commissioning and remediation of the 6 month project.

Walbridge Aldinger/Ford Motor Company- Hazard Assessments & Job Safety Oversight. Conducted hazard assessments & provided job safety oversight for the Ford Motor Company in Dearborn, Michigan at the historic Rouge Complex. Provided weekly assessments of the Rouge Powerhouse, post-explosion, for the sole purpose to provide contract safety oversight. Conducted monthly reviews of the facility to determine safety integrity and structural soundness for entry. Conducted daily and monthly safety inspections and audits for the new Ford engine plant at the same complex. Involved day-to-day interface with Ford engineers and design vendors during the commissioning of the plant. Performed audits on various functions during commissioning such as overhead hoist and cranes, machine guarding, and lockout/tagout of the equipment.

Environmental Options Inc. / Houston TX – Project Support. Provided OSHA and DOT technical support to the remediation division of Environmental Options mainly regarding environmental construction, transporting hazardous waste, UST's, and other Hazwoper regulated projects.

ENSR Corporation - Project Support. Developed Site Safety Plans for over 100 of projects, as well as performed other safety related responsibilities including- provide technical support to the industrial and commercial groups in both the OSHA General Industry Standard and OSHA Construction Standard. Major client focus was large petrochemical and oil refining facilities throughout Texas and Louisiana.

Fugro Environmental - Project Support. Develop Site Safety Plans as required under OSHA's-Hazardous Waste, Operations and Emergency Response Standard as well as perform other safety related responsibilities such as provide technical support to the industrial and commercial groups in both the OSHA General Industry Standard and OSHA Construction Standard.

Regulatory Compliance Evaluations

AT&T/Lucent - Environmental, Health and Safety Audit. Performed and coordinated environmental, health and safety compliance audits for AT&T in various facilities as part of a Master Service Agreement with AT&T. Responsibilities included identifying non-compliance to local, state and federal regulations in regards to EH&S activities as well as identifying non-conformance to AT&T safety practices. Locations were throughout the United States (Houston (2), Chicago, San Antonio (2) , New Orleans, South Bend, IN, Morristown, NJ, Freehold, NJ)

North Texas Cement Company - Health and Safety Audit /Program Development. Comprehensive health and safety audit for the North Texas Cement (NTC) terminal in Houston. NTC off-loads barges of portland cement into two storage domes, which in turn are transferred to truck and rail terminals. The audit was conducted in a week and involved a thorough walkthrough, document review, and assessment of offloading protocol. Consequently, developed the terminals confined space entry program and trained terminal employees and contractors on the program requirements.

Walbridge Aldinger/Ford Motor Company- Hazard Assessments & Job Safety Oversight. Conducted hazard assessments & provided job safety oversight for the Ford Motor Company in Dearborn, Michigan at the historic Rouge Complex. Provided weekly assessments of the Rouge Powerhouse, post-explosion, for the sole purpose to provide contract safety oversight. Conducted monthly reviews of the facility to determine safety integrity and structural soundness for entry. Conducted daily and monthly safety inspections and audits for the new Ford engine plant at the same complex. Involved day-to-day interface with Ford engineers and design vendors during the commissioning of the plant. Performed audits on

various functions during commissioning such as overhead hoist and cranes, machine guarding, and lockout/tagout of the equipment.

Aspen Bay Candle Manufacturing - Health & Safety Audit. Comprehensive health & safety compliance audit for Aspen Bay Candle Manufacturing facility in Starkville, Mississippi. Included walkthrough inspection, record review, job observations, design aspects and program review of the facility. A report was written in accordance with OSHA, standard building codes and National Electric Code.

Nutrition Technology Corporation - Health & Safety Audit. Comprehensive health & safety systems and compliance audit for Nutrition Technology Corporation in Monroe, Louisiana. Facility extracted oils from rice bran, which was stored in silos and tanks on 7 acres of property. Property was previously a cotton seed oil facility operating since the late 1800's, in which some buildings material handling where still operational. Included walkthrough observations, design aspects, record and program review, and a written report in accordance with OSHA and NEC.

New England Electric Wire Company - Health & Safety Assessment. New England Electric Wire Company engineers and manufactures specialty wire for various industries around the world. NEEWC uses raw product to develop numerous types of braided wire. A team conducted a "walk through" environmental, health, & safety compliance assessment for New England Electric Wire Company facility in New Hampshire. I was responsible for conducting the health and safety portion of the assessment. Included a site walkthrough assessment of the facility observing job observations, design aspects and identifying non-compliance items. A report was written in accordance with OSHA and the New Hampshire Health and Safety standards.

Summit Oil Company/ Klüber Corporation- Health & Safety Audit. Summit Oil Company manufactures, processes, and transports synthetic lubricants for air compressors in drums and other containers. Summit blends bulk, raw material to manufacturer a variety of products that are shipped nationally and internationally. A cross-sectional team was assembled to conduct a comprehensive environmental, health, & safety compliance audit for the facility located in Texas. Was responsible for conducting the health and safety portion of the audit. It included, performing interviews, record review, job observations, design aspects and identifying non-compliance items. Texas does not have a state health and safety program. A written report was developed in accordance with OSHA standards.

Waste Management- Health & Safety Audit. Waste Management - Emelle fully permitted facility in Alabama is a major hazardous waste treatment and disposal facility. The facility receives RCRA, TSCA, and other debris as waste in which is solidified, stabilized, and land-filled at the site. A cross-sectional team was assembled to conduct a comprehensive environmental, health, & safety compliance and management system audit for the facility located in Alabama. Was responsible for conducting the health and safety portion of the audit. It included, performing interviews, record review, job observations, design aspects and identifying non-compliance items. A comprehensive compliance and systems report was generated for WM EH&S.

John Carroll University - Health & Safety Audit. John Carroll University is a Jesuit university located in Cleveland, Ohio and enrolls approximately 4,000 students and employees approximately 600 employees. The university is a typical liberal university and has the standard programs and facilities that would be expected at a university such science departments, art departments, maintenance group, and a

physical plant. A cross-sectional team was assembled to conduct a comprehensive environmental, health, and safety compliance audit for the university. The University provided each member an escort for the week to assist in access and answer questions. Was responsible for conducting the health and safety portion of the audit. It included performing interviews, record review, job observations, design aspects and related non-compliance items. Ohio does not have a state health and safety program. A written report was developed in accordance with OSHA standards.

Gund Arena – Health & Safety Audit. Gund Arena is a world-class entertainment arena that hosts the NBA basketball franchise, Cleveland Cavaliers. The Arena also host numerous other events such as wrestling, concerts, indoor motor-cross, and a variety of other events. A team conducted a "walk through" environmental, health, & safety compliance audit. Was responsible for conducting the health and safety aspect of the audit. It included a walkthrough assessment of the facility observing job observations, design aspects and identifying non-compliance items. A thorough record and documentation of the Arena was also conducted. A report was developed in accordance with OSHA standards.

Aircraft Manufacturer– Safety Audit. Conducted safety audits at two aircraft facilities located in Georgia and Kansas over a two-week period. Both facilities are assembly plants, in which, the Kansas facility assembles entire aircraft. Audits included, performing interviews, record review, job observations, design aspects and identifying non-compliance items. Neither state has their own health and safety program. A written report was developed in accordance with OSHA standards.

Sunoco Chemical Company– Safety Audit. Active member of a multi-media EH&S audit team assigned to audit eleven Sunoco chemical plants and refineries. Currently, conduct safety audits at facilities around the country typically over a one-week period per site. The facilities range from polypropylene, phenol, cumene, lubes, and fuels. Audits include, performing interviews, record review, job observations, design aspects and identifying non-compliance items. A written report is developed in accordance with OSHA standards.

Amerada Hess– Safety Audit, Terminal. Conducted safety audit at a loading terminal located in South Carolina over a one-week period. The terminal receives, stores and transports various grades of petroleum fuels from barges. Audit included, performing interviews, record review, job observations, design aspects and identifying non-compliance items. The state of South Carolina does not have their own health and safety program. A written report was developed in accordance with OSHA standards.

Amerada Hess– Safety Audit, Production Platforms. Conducted safety audit at two Hess offshore platforms and corporate exploration and production (E&P) offices in Houston, TX over a one-week period. The platforms are manned platforms located in the Gulf of Mexico near Corpus Christi and produce natural gas. Audit included, performing interviews, record review, job observations, design aspects and identifying non-compliance items. A written report was developed in accordance with Mineral Management Services and Coast Guard regulations.

Hovensa Oil Refinery- Safety Support. Hovensa Oil Refinery (Formerly Hess Oil) is the largest oil refinery in the Western Hemisphere located in the Virgin Islands. Mr. Merrifield assessed the critical aspects of a major fuel explosion that occurred in an operating unit within the refinery. The review included emergency response deployment, mitigation, critique of the investigation and communication efforts to employees and community. Mr. Merrifield performed an in depth gap analysis of the refineries safety systems to determine the refinery's status in regards to potential certification to the OSHA

Voluntary Protection Program (OSHA-VPP). Once the analysis was completed, a detailed implementation plan and supporting programs were developed to assist the plant in implementing the VPP process at the refinery. The work performed required three weeks on site.

Miscellaneous

Various Commercial Clients - Indoor Air Quality Investigations. Developed ENSR's Houston office IAQ service line while participating in investigations, which resulted in the use of Anderson cascade impactors, bulk and swab sampling, and basic Metrosonic AQ501. The investigations included employee interviews, HVAC assessments, general building environmental conditions, and report writing.

National Broadcasting Corporation (NBC)- Hazard Assessments & Job Safety Analysis. Conducted hazard assessments & job safety analysis' (JSA) at seven different locations at major NBC studio's and stations located around the country. These assessments included performing interviews and assessments of key positions at each of the locations. Responsible for developing numerous written hazard assessments and JSA's for as many as 35 positions at each facility. The process was used as an open forum to allow NBC employee's to voice their safety concerns pertaining to their positions. These concerns were documented and included in a written report of the facility.

National Broadcasting Corporation (NBC Burbank) - EHS Program Support for the Voluntary Protection Program. Provided two weeks of on-site EHS program support by serving as EHS professional support primarily to provide assistance at the Mt. Wilson Transmission facility. The scope included a comprehensive health and safety compliance/management system audit (CALOSHA, GE Standards), completion of job safety analysis' and hazard assessments, conduct a chemical review and inventory, and train employees on lockout/tagout procedures. Developed an extensive "Emergency Action Plan" for Mt. Wilson that incorporates the various emergencies possible at the site with the required interface needed for a response to a "remote" location such as Mt. Wilson.

Hotel Dieu Grace Hospital (Windsor, Canada) Consultation and Delineation of Mold Contamination. Ongoing support for a large general contractor working within a Canadian hospital that has been "alleged" to create conditions to support black mold contamination in multiple locations of a newly constructed wing of an existing hospital. A very sensitive and visible project that has the Canadian "Ministry of Labour" actively involved. Activities included collecting core and cellophane tape samples, delineation of mold spores on CADD, report development, legal support, and conducted a two day training class for employees on the safe removal of the mold spores (similar to asbestos training).

EDUCATION

B.S. Safety Engineer - Murray State University

PROFESSIONAL AFFILIATIONS

National Environmental Trainers Association/
American Society Safety Engineers

Christopher L. Merrifield

TECHNICAL SPECIALTIES

- Process Safety Management Training (Hazard operability studies, Process Change Analysis, Management of Change, & Fault Tree Analysis)
- EPA, Indoor Air Quality and sampling protocols
- Certified Environmental Trainer, NETA (expired)
- Instructor in Louisiana and Texas Asbestos Courses Contractor/Supervisor, Worker, Inspector, Project Designer, Air Monitoring Technician, Management Planner, Texas Regs., Louisiana Regs.
- 80 Hour Association of American Railroads and BOE, Hazardous Material Technician
- BSI-Advanced EMS Lead Auditor for ISO14000, 98-0077US-48390
- Advanced Industrial Firefighting, Strategies/Tactics, Incident Command, Technician (40e, 24q, Supervisor)
- Confined Space Rescue-Regular and Advanced OSHA-"Voluntary Protection Program"
- Industrial Hygiene Techniques and Sampling for Emergency Response
    - Certified in Excavation and Scaffold Safety

BAN N. SHAMOON
Environmental Scientist

Summary of Qualifications

Ms. Shamoon is an environmental scientist with four years of technical and manufacturing experience. With a scientific background Ms. Shamoon has experienced many different realms of industry. The following are Ms. Shamoon's major areas of expertise.

Relevant Experience

RCRA Facility Investigations. Task Manager for large scale RCRA facility investigation. Responsible for field implementation of RCRA facility investigation work plan. This includes designing field investigations, and coordinating field activities. Other responsibilities include managing field and laboratory data by utilizing access and EquIS Chemistry. Additional tasks include interpreting data utilizing ArcGIS 8.0 and Surfer, and producing data release packages.

Risk Communication. Formally trained in Risk Communication including media relations and high risk conditions. Participated in off-site contaminant migration investigations as a technical risk communicator. Provided technical assistance and support to neighbors including commercial businesses, residents, municipalities, and local police. Aided in coordination and oversight of field activities. Investigations required constant communication with team members and community.

Brownfield Sites. Participated in redevelopment of brownfield sites. Major role was to manage all funding sources for redevelopment ultimately equaling $3,000,000.00. Participation in other brownfield activities includes research of brownfield programs in various states. Attended the 2001 National Brownfields Conference, the 2001 Michigan Municipal League Conference, and the 2001 Deal Flow Conference.

Phase I Environmental Site Assessments. Participated in environmental site assessments for commercial and industrial properties in accordance with standards established by the American Society for Testing and Materials, Environmental Site Assessments, E 1527-00. These studies involved in-depth background research including review of historical and current aerial photographs; evaluation of UST registrations; review of State and Federal databases; site inspections; and surrounding property usage evaluation.

Securities and Exchange Commission (SEC) Audits. Participated in assessing and reporting environmental liability for industrial properties in accordance with the American Institute of Certified Public Accountants "Statement of Position 96-1, Environmental Remediation Liabilities." Participation includes site walk through, in-depth background research, and determination of regulation requirements to be met.

Litigation Research. Conducted rigorous technical and literary research in order to obtain supporting documents for expert witness opinion. Research included scholarly document studies, Internet and database research, and interviews with industry personnel. Technical

studies included the study of chemical behaviors as well as proposing chemical reactions and mechanisms.

Previous Experience

Environmental/Quality Analyst. Evaluate and report data for government air emissions standards. Monitor and report compliance of wastewater with government standards. Maintain chemical inventory in accordance with OSHA and MIOSHA. Assist in treatment and disposal of hazardous waste. Aid in safety training of new and existing employees. Evaluate test data and issue certificates of compliance. Evaluate customer complaints and internal nonconformance for trends. Aid in maintaining compliance in accordance with ISO9001 and QS9000. Evaluate and maintain employee-training program. Develop and update standard operating procedures. Develop Statistical Process Control training. Conduct research for implementation of ISO14000.

Research and Development Assistant Chemist. Resolve surface issues through surfactant studies. Test for and maintain compliance of VOC standards of products. Test and measure characteristics of products. Aid in formula optimization through extensive testing. Collect and record research data for analysis.

Research Technician. Protein quanitation of samples. Thin layer chromatography for separation of samples. Column chromatography for purification of sphingolipids. Capillary electrophoresis for separation of sphingolipids. Ultraviolet/Visible spectroscopy for evaluating concentration of gangliosides.

Laboratory Experience. Gas chromatography, gas chromatography/mass spectroscopy, gel electrophoresis, centrifugation/ultra centrifugation.

Education

Bachelor of Science in Biochemistry, Oakland University, Rochester, Michigan, 1999
OSHA 40 Hour HAZWOPER Training (29 CFR 1910.120 (e)(3)(I)), September 2000
OSHA 8 Hour HAZWOPER Refresher Training (29 CFR 1910.120(e)(8)), updated annually
Environmental Quality Information Systems' Chemistry© Data Management System (EquIS) Training, March 2001
ASTM Technical and Professional Training; "Environmental Site Assessments for Commercial Real Estate", August 2002

Computer Experience

AutoCAD, ArcView GIS 3.2 and 8.0, EquIS Chemistry, Access, Surfer, gINT

Organizations
Member of CHMM and AWMA

GREGORY P. LIEDEL
Senior Environmental Geologist

Summary of Qualifications

Mr. Liedel is an environmental geologist with more than 12 years experience in site assessment and remediation. With a geology and geography background, Mr. Liedel has been a significant contributor to several site assessments, Phase I/Phase II investigation, remedial site investigations, and building decommissioning. The following are specific examples of Mr. Liedel's major areas of expertise.

Relevant Project Experience

Building Decommissioning. Supervised a coal and hazardous materials decommissioning project for a large automotive complex. Provided oversight of building entry staff assigned to work crews entering buildings for safety, inspection and approval of work performed by the contractors, running the daily morning entry staff safety meetings, running the daily afternoon contractor progress meetings and providing daily/weekly memos to key personnel and the client's organizations.

Asbestos-related Activities. Supervised work activities and conducted air monitoring during asbestos abatement projects. Performed analytical testing of asbestos in air and bulk samples utilizing the Phase Contrast Microscopy (PCM), Polarized Light Microscopy (PLM) and Transmission Electron Microscopy (TEM) methods. Conducted asbestos surveys for projects ranging from residential dwellings to industrial complexes.

Lead-based Paint Activities. Performed lead-based inspections and risk assessments of residential to industrial complexes utilizing an X-ray Fluorescence (XRF) Spectrum Analyzer.

Phase I Environmental Site Assessments. Conducted environmental site assessments for commercial and industrial properties in accordance with standards established by the American Society for Testing and Materials, Environmental Site Assessments, E 1527-00. These studies involved in-depth background research including review of historical and current aerial photographs; evaluation of UST registrations; review of State and Federal databases; site inspections; and surrounding property usage evaluation.

Site Assessments. Performed site assessment and investigation projects performed pursuant to Part 201 of Michigan Public Act 451 of 1994, as amended. Development and implementation of hydrogeologic investigations; coordinate subcontractors and equipment for field investigation, implementation of field investigations including soil/groundwater sampling pursuant to USEPA protocol, and supervising well design and installation pursuant to USEPA technical enforcement guidance. Prepared Baseline Environmental Site Assessments for submittal to the Michigan Department of Environmental Quality.

Petroleum Impacted Sites. Project manager for site assessment and investigation projects performed pursuant to Part 213 of Michigan Public Act 451 of 1994, as amended. Development and implementation of hydrogeologic investigations; coordinate subcontractors

and equipment for field investigation, implementation of field investigations including soil/groundwater sampling pursuant to USEPA protocol, and observing well design and installation pursuant to USEPA technical enforcement guidance. Prepared appropriate reports for submittal to the Michigan Department of Environmental Quality. Performed Tier I and Tier 2 site closures under the Risk Based Corrective Action which have included several with deed restrictions.

Education

University of Toledo, B.S. Geology, 1990
University of Toledo, B.A. Geography, 1989

Special Studies and Courses

OSHA 40 Hour HAZWOPER Training (29 CFR 1910.120 (e)(3)(I)), 1991
OSHA 8 Hour HAZWOPER Refresher Training (29 CFR 1910.120(e)(8)), updated annually
Risk-based Corrective Action Trained

Professional Certifications and Registrations

1999/Licensed Professional Geologist: State of Indiana (Reg. No. 1721)
2001/Certified Underground Storage Tank Professional (CUSTP): State of Michigan

STEPHEN SONG, Ph.D.

EDUCATION

1986 Ph.D., Water Resources Engineering, University of California, Los Angeles

1982 M.S., Water Resources Engineering, University of California, Los Angeles

1979 B.S., *cum laude,* Civil Engineering, University of California, Los Angeles

EXPERIENCE

Dr. Song is a Principal at ENVIRON Corporation. He has 16 years of consulting and industry experience in hazardous waste management, including extensive experience in: the development and application of risk-based approaches to improve site investigation and remediation; regulatory negotiations; RCRA compliance; and regulatory analysis. His project management experience includes major projects under the following regulatory programs:

- RCRA Facility Investigation (RFI) and Corrective Measures Study (CMS);
- RCRA Closure and Post-Closure;
- Superfund Removal Action;
- Superfund Remedial Design (RD) and Remedial Action (RA); and
- Underground Storage Tank (UST) Removal and Corrective Action.

Dr. Song's areas of technical and regulatory expertise include:

- Human health risk assessment;
- Fate and transport modeling;
- Statistical analysis of environmental data; and
- RCRA hazardous waste management.

The following describe some of Dr. Song's work at ENVIRON:

- Directed an RFI baseline risk assessment for a major automotive manufacturing facility in Ohio where potential exposures to workers and neighboring residents from more than a dozen SWMUs, including landfills, surface impoundments, and USTs, were assessed. Dr. Song lead extensive negotiations that succeeded in convincing USEPA Region 5, possibly for the first time in an RFI, to allow future land use to be assessed as industrial, rather than residential, and ground water exposures to be assessed at only existing drinking water wells which were off-site and screened in a lower, rather than the uppermost, aquifer.

- Designed and obtained approval from the Pennsylvania DEP for an RFI/CMS in which the field work and baseline risk assessment were phased with the phase-out of production at a major chemical manufacturing facility in Pennsylvania. Dr. Song directed the baseline risk assessment which included evaluation of potential exposures to workers and neighboring

residents during excavations into shallow, contaminated ground water, and to users of off-site surface water that may be affected by transport of ground water from the facility.

- Directed the development of risk-based soil and ground water criteria for protection of human health at industrial facilities in the People's Republic of China, on behalf of a major US-based multinational automobile manufacturer. Presented the criteria before the China National EPA on two occasions, and successfully negotiated over a two-year period the adoption of the criteria as national guidance. The development work included original research to derive exposure factors (e.g., exposure frequency, exposure duration, skin surface area, and body weight) that were specific to workers in China.

- Served as a subject-matter expert on human health risk assessment for the U. S. Army's Environmental Restoration Independent Technical Review Program, which uses independent subject-matter experts to assist the Army in identifying opportunities for improving the cost-effectiveness of investigations and remediations at Base Realignment and Closure (BRAC) installations and active Army sites.

- Provided technical guidance to Ohio EPA on the use of Monte Carlo techniques in the development of generic risk-based soil and groundwater cleanup standards under the Ohio Voluntary Action Program (a brown fields program), on behalf of an Ohio industry coalition.

- Provided technical guidance to Michigan DEQ on the use of vapor and particulate emission models, air dispersion models, and vapor intrusion models in the development of generic risk-based soil and groundwater cleanup criteria under Michigan's site remediation rules (Part 201 Rules, formerly Act 307 Rules), on behalf of a Michigan industry coalition.

- Developed comments on USEPA's December 1994 draft Soil Screening Guidance for several industrial clients. The comments critiqued the technical basis of the draft risk-based approach, identified technical errors in the USEPA methodologies, and suggested alternate methods to improve the efficiency of the soil screening levels.

- Directed the RD/RA of an operable unit at a major Superfund site in USEPA Region 3. Dr. Song negotiated changes to the $22 million remedy specified in the ROD that saved the PRPs more than $10 million. The RD/RA included segregation and characterization of admixed hazardous wastes that were disposed in a 5,000 yd^3 in-ground vault and design of technologies to treat the wastes to meet RCRA land disposal restrictions treatment standards.

- Developed and successfully negotiated with USEPA Region 4 a risk-based screening methodology for evaluating broad-spectrum (i.e., TCL/TAL) soil characterization data collected at more than 45 sites in six states under a CERCLA 106(a) order. The screening methodology allowed estimates of cumulative excess cancer risk and estimates of noncancer effects to be compared with an acceptable risk of 10^{-4} and a hazard index of 1, respectively.

- Assisted the Michigan Part 201 Program Advisory Group (formerly Act 307 Program Advisory Group) in the development of the technical details for standard default risk-based cleanup standards appropriate to industrial land use under Michigan's Natural Resources and Environmental Protection Act (NREPA, formerly Act 307). The standards, in part, are based on Monte Carlo analysis of multiple, human exposure pathways.

- Developed comments on Ohio EPA's 1993 *Guidance for Reviewing Risk-Based Closure Plans for RCRA Units* and *Closure Plan Review Guidance for RCRA Facilities*, on behalf of a major automotive manufacturer. The comments offered suggestions on technical aspects of Ohio EPA's approach to risk-based clean closures and on streamlining the administrative review of closure plans.

- Directed the development of risk-based screening levels for lead, including soil screening levels appropriate to workers at industrial sites and screening levels appropriate to recreational consumption of fish.

- Developed an expert report that refuted a RCRA Section 7003 "imminent and substantial endangerment" claim against a large inactive land disposal site located on a major river in Illinois.

- Developed an expert report on the historical regulatory framework governing RCRA-related remedial actions and the implementation experience during the 1980s to early 1990s at the federal and state levels.

- Provided expert review of RCRA hazardous waste classification issues and assisted in the development of litigation strategy.

Before joining ENVIRON, Dr. Song served seven years with the General Motors Corporation (GM), Environmental Activities Staff. While at GM, he provided oversight and technical support in RCRA compliance to more than 100 manufacturing facilities. Dr. Song led the development of GM strategies and procedures for managing RCRA-related remedial activities including corrective action, closure/post-closure, UST removal/cleanup, and facility closing/sale. He also conducted legislative and regulatory negotiations and analysis on a variety of RCRA and Superfund issues on behalf of GM. His work at GM included the following:

- Led a coalition of major Michigan industries in successful negotiations with Michigan DEQ and environmental advocacy groups to develop the first workable cleanup standards under Michigan's Superfund law (formerly Act 307). Dr. Song contributed the key concepts to the development of Michigan's three-tier approach to setting risk-based cleanup standards and Michigan's standard default risk-based cleanup standards for industrial land use.

- Provided technical guidance on RCRA closures and post-closures of hazardous waste management units at more than two dozen GM manufacturing facilities. These closures included container management units, tanks, surface impoundments, waste piles, and landfills.

As part of these closures, Dr. Song led successful negotiations with the regulatory agencies in Michigan, Ohio, and Missouri to approve the first risk-based RCRA clean closures in those states.

- Developed strategies and procedures for managing RCRA corrective action at more than 100 manufacturing facilities. The strategies and procedures addressed management of the Visual Site Inspection (VSI) and Sampling Visit (SV), challenge of the RCRA Facility Assessment (RFA), negotiation of the order/permit, voluntary corrective action, and management of the RFI/CMS. Dr. Song provided oversight and technical assistance on RCRA corrective actions at GM facilities in USEPA Regions 3, 5, and 7.

- Developed management strategies and technical guidance for environmental site assessments at more than two dozen GM manufacturing facilities that were closing, redeveloped, or sold as ongoing operations. Because many of these facilities were subject to RCRA corrective action but have not yet come under enforcement, these strategies considered future corrective action impacts and preemptive measures to minimize their potential effect.

- Established and led the implementation of a plan for risk ranking and preemptive assessment of more than a dozen inactive hazardous waste sites to minimize potential environmental liability.

- Developed position papers and testimony on major proposed rules under RCRA and TSCA.

Dr. Song also held the following positions:

- Adjunct Assistant Professor, School of Health Sciences, Oakland University, Rochester, Michigan. Developed and taught a senior-level course examining scientific and public policy issues in environmental protection, covering RCRA, CERCLA, Clean Water Act, and Clean Air Act.

- Post-Graduate Research Engineer, School of Engineering and Applied Science, University of California, Los Angeles. Developed and calibrated a mathematical model of mass transport-limited nitrification kinetics in activated sludge. Supported other research and pilot studies on other biological wastewater treatment processes.

- Pilot Plant Operator, Pentech Houdaille, Houdaille Industries, Inc., Cedar Falls, Iowa. Assisted in evaluating the performance of an air/pure-oxygen activated sludge pilot plant at the Hyperion Wastewater Treatment Plant in Los Angeles, California.

PROFESSIONAL MEMBERSHIPS AND ADVISORY POSITIONS

Member, Michigan Act 307 Program Advisory Group, Michigan Department of Natural Resources, 1991-1992.

Member, Michigan Act 307 Rules Work Group, Michigan Manufacturers Association and Michigan Department of Natural Resources, 1989.

Member, Michigan Ground Water Quality Standards Rules Work Group, Michigan Department of Natural Resources, 1990.

Member, Serious Reduction of Hazardous Waste Workshop, Large Business Perspectives on Hazardous Waste Reduction, Office of Technology Assessment, U.S. Congress, 1986.

Member, American Society of Civil Engineers.

PRESENTATIONS AND PUBLICATIONS

Song, S. 1999. Human Health Risk Assessment in RCRA Corrective Action and Superfund. 1999 General Motors Global Environmental Conference, Detroit, Michigan. October.

Song, S. and K. Cizerle. 1998. RCRA Land Disposal Restriction Treatment Standards. Technical training seminar for the U. S. Naval Facilities Engineering Service Center at eight Naval Facilities Engineering Command Divisions. October.

Cizerle, K., S. Song, S. Washburn. 1998. Potential Risks Associated with Vapor Migration from Groundwater into Buildings. *Risk, Resources, and Regulatory Issues: Remediation of Chlorinated and Recalcitrant Compounds.* First International Conference on Remediation of Chlorinated and Recalcitrant Compounds. Battelle Press: Columbus, Ohio.

Song, S. 1997. Risk-Based Soil and Groundwater Quality Standards for Industrial Facilities in People's Republic of China. China National Environmental Protection Agency. Beijing, People's Republic of China. June (also January 1998).

Song, S. 1996. Development of Risk-Based Screening Criteria for Industrial Sites in Mexico. Instituto Nacional de Ecologia (INE), Procuraduria Federal de Proteccion al Ambiente (PROFEPA), and Secretaria de Comercio y Fomento Industrial (SECOFI). Mexico City, Mexico. April.

Song, S. and L. Rosolowsky. 1995. Improving EPA's Soil Screening Guidance. Society of Risk Analysis Annual Conference. Honolulu, HI. December.

Washburn, S. and Song, S. 1995. Practical Guidance on CERCLA Risk Assessment. Training seminar for the Mobile Oil Corporation, Superfund Group. Princeton, NJ. June.

Song, S. 1993. Texas Risk Reduction Rules: Exposure Assessment Issues. ENVIRON client seminar. Houston, TX. June.

STEPHEN SONG, Ph.D.

Song, S., and L. Marolf. 1993. Michigan's Three-tier Approach to Setting Cleanup Standards for Sites of Environmental Contamination. Water Environmental Federation Specialty Conference on The Development of Soil, Sediment, and Groundwater Cleanup Standards for Contaminated Sites--How Clean Is Clean? Washington, D.C. January.

Stenstrom, M.K. and S. Song. 1991. Effect of oxygen transport limitation on nitrification in the activated sludge process. *Res. J. Water Pollut. Control Fed.*, **63**, 208.

KIMBERLEY D. CIZERLE

EDUCATION

1991 M.S.E.E., Environmental Engineering (Water Resources Engineering), University of North Carolina at Chapel Hill

1989 B.S., Nuclear Engineering (Minor in Spanish), North Carolina State University

EXPERIENCE

Ms. Cizerle is a Manager at ENVIRON Corporation with a broad engineering background and over eleven years of industry and consulting experience in:

- Human health risk assessment, including fate and transport modeling
- Site assessment and remediation
- Regulatory negotiations
- Regulatory analysis
- RCRA hazardous waste management
- Evaluation of litigation claims based on the principles of risk assessment

The following describe some of Ms. Cizerle's work at ENVIRON.

- Managed several risk-based evaluations for various RCRA Facility Investigations (RFIs) in Ohio, Indiana, Georgia, and Michigan.

- Managed risk-based evaluations for RCRA RFI activities and corrective measures determinations for a facility in Indiana, under a voluntary agreement with USEPA Region 5.

- Prepared RCRA environmental indicator (EI) evaluations for various high-priority sites listed for evaluation in USEPA Region 5.

- Conducted a risk-based evaluation of remedial alternatives and developed risk-based targets for the selected remedy for a RCRA corrective measure study/feasibility study (CMS/FS) in USEPA Region 2.

- Developed strategy for conducting RCRA corrective action activities at an active RCRA Subtitle C treatment, storage, and disposal facility (TSDF). On behalf of the facility, prepared comments to USEPA Region 5 on the corrective action portion of its RCRA federal permit modification.

- Managed a risk-based screening evaluation of TCL/TAL soil characterization data collected at more than 45 sites in six states under a CERCLA 106(a) order. The evaluation included estimation of cumulative excess cancer risk and noncancer effects (to be compared with an acceptable risk of 10^{-4} and a hazard index of 1) at each of the 45 sites for on-site industrial and off-site residential land use.

- X Managed a human health evaluation of soil and ground water data at a former automotive components and manufacturing facility in New York. The evaluation included the development of a risk-based screening level for lead for workers at the industrial facility.

- X Evaluated, based on human health risk assessment, the significance of soil and ground water data collected as part of various Phase I assessments at several former facilities in California and Kansas. Provided technical support to the seller during its property transaction negotiations.

- X Managed the development of risk-based soil and ground water criteria for protection of human health at industrial facilities in the People's Republic of China, on behalf of a major US-based multinational automobile manufacturer. This work included original research to derive exposure factors (e.g., exposure frequency, exposure duration, skin surface area, body weight) that were specific to workers in China.

- X Provided technical guidance to Michigan DEQ on the use of vapor and particulate emission models, air dispersion models, and vapor intrusion models as part of DEQ's development of generic soil cleanup criteria under Michigan's site remediation rules (Part 201 Rules), on behalf of a Michigan industry coalition. Developed tools to calculate the vapor emission flux for chemicals in soil at finite (rather than infinite) depths of contamination. Developed and justified reasonable generic inputs for many key parameters in the vapor intrusion model.

- X Provided comments to Indiana DEM on its draft guidance for conducting risk-based site cleanups and closures, on behalf of an Indiana industry coalition. Served as the technical leader of the industry coalition in meetings and negotiations with Indiana DEM to discuss the coalition's comments and suggestions for revisions to the state's draft guidance.

- X Evaluated risk-based elements of several state regulatory programs and compared these with the ASTM risk-based corrective action (RBCA) process, in preparation for ASTM RBCA training seminars. Also performed analysis of USEPA's RCRA corrective action program as compared with the ASTM RBCA process.

- X Prepared summaries and analyses of the risk-related provisions of various environmental regulatory programs (Clean Air Act, Clean Water Act, Safe Drinking Water Act, Resource Conservation and Recovery Act, Comprehensive Environmental Response, Compensation and Liability Act, and Superfund Amendments and Reauthorization Act) to assist a chemical company in developing risk-based approaches that can be incorporated into its environmental management system.

- X Prepared RI/FS reports for several natural gas compressor stations in New York and developed strategy for negotiations with NYSDEC on the analysis and selection of remedial alternatives.

X Managed the RD/RA of an operable unit at a major Superfund site in USEPA Region 3. Ms. Cizerle's work on this project included the following:

- negotiated with USEPA to change the $22 million ROD remedy, which saved the PRPs over $10 million
- RCRA hazardous waste characterization, and design of fixation and incineration treatability tests to treat wastes to meet RCRA land disposal restriction (LDR) treatment standards
- negotiated with USEPA to issue a treatability variance per 40 CFR Part 268.44 for a portion of the remediation wastes (RCRA hazardous soil) to allow for alternate, less stringent, treatment standards than the LDRs
- prepared several remedial design reports for on-site removal and off-site fixation and incineration of RCRA hazardous wastes
- managed and provided oversight of remedial action contractors responsible for hazardous waste sampling, removal, and treatment

X Developed strategies and provided regulatory analyses and guidance to numerous industrial clients regarding compliance with RCRA LDR treatment standards for RCRA hazardous wastes, debris, and soil.

X Developed and presented a two hour seminar/training course regarding RCRA LDR treatment standards for RCRA hazardous wastes, debris, and soil. The seminar was provided at eight different locations to various project managers responsible for developing and implementing remedial action plans at military bases throughout the country.

X Evaluated the feasibility of successfully delisting various RCRA listed hazardous waste streams (per 40 CFR Part 260.22 and associated USEPA guidance) contained in lagoons and landfills at various automotive manufacturing facilities in Ohio.

X Evaluated USEPA's new Delisting Risk Assessment Software model (DRAS, September and December 2000) and guidance for RCRA hazardous waste delisting. Developed comments for submittal to USEPA, and held discussions with USEPA Region 5 regarding its delisting policy. Developed comments to USEPA Regions 5 and 6 on various site-specific delisting notices proposed in the Federal Register.

X Developed comments on USEPA's proposed HWIR-waste rule (proposed November 1999, with additional proposals in April and July 2000), for submittal to USEPA on behalf of a major automobile manufacturer.

X Managed development of a Waste Analysis Plan (WAP) per 40 CFR Part 268.7 and corresponding Ohio EPA regulations for an active RCRA Subtitle C TSDF in Ohio. Led technical negotiations with Ohio EPA regarding key elements of the WAP and the facility's strategy for complying with RCRA TSDF waste analysis requirements.

X Managed litigation support efforts for a RCRA citizen's lawsuit filed under RCRA Section 7003. Developed and implemented strategy for evaluating whether buried materials at a site

posed an "imminent and substantial endangerment" to human health and the environment. Technical analyses included fate and transport modeling to estimate possible exposure concentrations attributable to the buried materials, and assessment of potential risks associated with the buried materials.

X Managed litigation support efforts to evaluate a toxic tort lawsuit regarding possible residential exposures to chemicals associated with a nearby municipal landfill. Technical analyses included: (1) estimation of possible exposure concentrations to residents by various exposure routes and pathways, with a focus on residential exposures via inhalation of volatile organic chemicals, and (2) evaluation of whether the reported health effects were attributable to the landfill based on the constituents and concentrations reported.

X Ms. Cizerle has also conducted Phase I Environmental Assessments for several properties in New Jersey.

Prior to joining ENVIRON, Ms. Cizerle held the following positions:

X Research Assistant, Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill. Coordinated the installation of water meters in various rural water systems of Guatemala, Honduras, and Ecuador to determine actual water use rates, peaking factors, and storage requirements. Ms. Cizerle used this information to select and recommend improved design standards for rural water supply systems in Latin America.

X Legal Assistant, Legal Department, Carolina Power and Light Company. Provided corporate litigation support, including technical review of documentation in support of litigation for various nuclear and coal power plants.

X Environmental Sciences Section (Environmental Compliance Unit), Carolina Power and Light Company. Conducted site investigations and environmental compliance reviews of nuclear, coal, and hydro power plants. Wrote Oil Spill Prevention Control and Countermeasure (SPCC) Plans and Hazardous Waste Handling Procedures for use in the company's facilities and power plants.

AWARDS

Frederico Gil Award for the Best Masters Paper on a Latin American Topic at the University of North Carolina at Chapel Hill. Award given for Masters Paper entitled *Analysis of Design Standards for Latin American Water Systems*.

KIMBERLEY D. CIZERLE

PUBLICATIONS AND PRESENTATIONS

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APPENDIX B

ENVIRON Qualifications

Corporate
Qualifications

ENVIRON

An Overview

Introduction

Today, decision makers are increasingly called upon to consider the consequences of their actions to human health and the environment. Indeed, the very options frequently being weighed involve choices between alternative courses of action to balance health and environmental risks and economic concerns. In today's world, the difference between effective and ineffective risk management can be the difference between success and failure.

At ENVIRON, we understand the pitfalls and obstacles facing decision makers. We also understand the serious liabilities that can result from inappropriate decisions. That is why we have assembled an outstanding, multidisciplanary group of scientists and engineers to assist our clients in addressing the complex technical, scientific, and policy issues associated with their risk management decisions.

Whether the situation calls for a single expert witness, a team of technical professionals, or a crew of qualified field personnel, we have the resources to assemble a project team befitting the need.

Since our founding in 1982, decision makers have relied on ENVIRON's technical experts in a wide variety of matters involving chemical risks to human health and the environment. Our professionals assist clients in effectively managing risk, whether the issue at hand is evaluating possible liabilities associated with a commercial transaction; demonstrating the safety of a drug, medical device, food additive, industrial chemical, or consumer product; determining the environmental fate and transport of chemicals; characterizing the nature and extent of site contamination and designing an effective remedy; providing technical and strategic support in toxic tort and product liability litigation; or in other ways addressing the risks associated with exposure to toxic substances.

Unrivaled Expertise

At ENVIRON, we have assembled a team of scientists, engineers, and policy specialists with unrivaled educational and professional credentials, and unmatched sophistication and insight. The members of our professional consulting staff have studied and conducted research at some of the finest institutions and in the most well-respected programs in their disciplines. More than 80% have advanced degrees. A full 30% have earned doctorates, often with post-doctoral experience. We bring together these high-caliber professionals from diverse health science, environmental science, and engineering disciplines—from toxicology, epidemiology, and public health...to geology and hydrogeology...to civil, chemical, and environmental engineering, to name a few. Most of our principals are nationally recognized experts in their fields, with at least fifteen years of relevant experience. They direct a group of talented professionals who come to ENVIRON form a variety of arenas, including academia, industry, government, public interest, and consulting. Many have served on important committees that influence the direction and establishment of public policies and programs.

Our technical experts are widely published in their fields. Many regularly contribute articles to peer-reviewed publications, sit on the editorial boards of professional journals, and present papers or chair sessions at professional symposia and conferences.

Effective Communication

Risk management decisions are presented in a variety of forums and must address a diversity of perspectives. The ability to synthesize and communicate complex technical, economic, and policy issues is critical to the successful adoption of proposed solutions. Because decision makers frequently rely on the support of technical experts to advocate their positions, effective communication is an integral component of a consulting engagement.

Critical to effective communication in all arenas is establishing credibility and trust. And in the regulatory, legal, business, and public forums that weigh risk management decision, conveying complex information in a manner that clearly addresses the underlying concerns of these audiences is essential.

At ENVIRON, our record of success in representing clients in these diverse forums is unparalleled.

Areas of Practice

Air Quality

ENVIRON's nationally recognized air sciences and engineering professionals offer a full spectrum of air quality services:

- **Air emissions and dispersion modeling**—from industrial facilities and hazardous waste sites, including siting studies and air toxics impact evaluations
- **Exposure assessment analysis**
- **Air pollution compliance assistance**—including compliance auditing, regulatory analysis, and obtaining local and state permits, as well as Federal Title V operating permits
- **Ambient and indoor monitoring**—program design and implementation
- **Process engineering**—including process modifications to suppress or eliminate emissions, to recover and recycle process chemicals, or to control criteria and hazardous air pollutants
- **Design, engineering, and construction management**—for process modifications and emissions control systems
- **Emergency release modeling**—including off-site consequence analysis
- **Advanced regional/urban modeling**—including emissions, photochemical, reactive plume, particulate matter, toxics, and visibility modeling and model development
- **Comprehensive air quality/meteorological/emissions monitoring**—to support integrated model application and evaluation
- **State Implementation Plan (SIP) and Federal Implementation Plan (FIP)**—consulting services, including the development of regional emissions inventories
- **Regional air quality impacts analysis**—for alternative control strategies, including advanced vehicles, alternative and reformulated fuels, and other mobile and stationary source control measures
- **Leak detection and repair services**—including monitoring equipment recommendations, software/data base management system design, program management consulting, and field services
- **Statistical and data analysis**—of complex environmental data bases
- **Transportation/air quality conformity analysis**

Setting ENVIRON apart from other consulting firms, the nature of our engagements is often strategic. We interact directly with senior corporate or agency personnel or with legal counsel to help our clients design innovative, proactive strategies for managing air quality issues. No matter what the issue, we focus on the ultimate air quality considerations—health and environmental impacts, and attaining and maintaining air quality standards cost-effectively—either by specifying and implementing process changes or by controlling emissions.

When the standard approaches do not apply or give unrealistically conservative results, our professionals rely on their cutting edge thinking, which at times requires developing innovative models. We use the best, most appropriate science to frame strategic choices for decision makers, helping them balance public health and environmental concerns, compliance costs, and corporate and public resources and priorities.

Environmental Liability Assessments

ENVIRON has performed thousands of comprehensive, multimedia environmental assessments of:

- industrial properties in almost every standard industrial category
- commercial & residential developments
- undeveloped properties
- hazardous waste sites

We perform these assessments on behalf of:

- owner/operators
- sellers
- buyers
- lending institutions

ENVIRON tailors the scope of an environmental assessment to the particular concerns at the facility(ies), the financial resources available for the assessment, and the confidence level desired by the client. Our multiple offices in the U.S. and abroad enable us to conduct simultaneous assessments at numerous locations with far-ranging complexity and geographic distribution. The fundamental risk assessment orientation that ENVIRON brings to this practice is instrumental to clients not only in quantifying risks, but also in developing strategies to reduce or avoid these risks.

Assessments are generally conducted in phases. The Phase I assessment typically involves:

- a site inspection
- a review of relevant documents on the facility's past and current operations and environmental practices, including historical aerial photographs
- a review of environmental permits and correspondence with regulatory agencies on compliance
- interviews with persons knowledgeable of the site's current and past operations
- a review of historical or current uses of neighboring properties to determine if neighboring operations could have an adverse environmental impact on the subject property
- a review of applicable state and Federal data bases to learn of any hazardous waste and chemical release issues at the site, as well as at surrounding facilities
- interviews with regulatory officials to identify areas of concern or potential liabilities (with the permission of the client)

A Phase II field sampling investigation can be conducted if the assessment indicates the potential for significant on-site contamination or significant risk relative to the transaction. Field sampling provides a better understanding of the nature and extent of contamination and supports an estimate of compliance or remediation costs.

ENVIRON's seasoned experience in site investigation and remediation, including remedial design engineering, positions us well to assist clients with Phase III and beyond, should that be necessary.

(BACT), and other areas relevant to the permitting process. Through our depth of experience in litigation support and expert testimony, we are able to articulate clearly the complex issues and analyses upon which legal cases and public hearings are based.

Human Health Risk Assessment

ENVIRON has conducted hundreds of risk assessments on more than 100 specific chemical agents in a broad range of project areas involving:

- complex hazardous waste sites
- current and former industrial manufacturing facilities
- municipal and hazardous waste disposal facilities
- leaking underground storage tanks
- incinerators
- abandoned mining sites
- pesticide-contaminated agricultural land
- large-scale petroleum spills and releases
- production or disposal of products
- compliance with statutes regulating chemical releases
- obtaining permits for manufacturing or process facilities
- chemicals in food and consumer products; drugs and biologics; medical devices; workplaces

We have extensive experience in identifying the level of inherent chemical hazards, evaluating the potential for exposure of populations and exposure pathways, and evaluating the potential risk to human health from chemical exposure.

Scientific Skills

The sound conduct of risk assessment rests upon two broad sets of scientific skills—

- those pertaining to toxicology and the related health sciences, including epidemiology and biostatistics
- those pertaining to the evaluation of the magnitude of human exposure to chemicals of interest

ENVIRON has thus built strong staffs in both these disciplinary areas, who work closely together to develop a thorough understanding of the biological and physical-chemical properties underlying the assessment of toxicology and potential for human exposure.

Risk Communication

Beyond conducting a risk assessment lie the difficult but essential tasks of explaining and justifying risk assessment results—sometimes to regulators, sometimes to the courts, and increasingly often to the public. These efforts require a combination of good communication skills and scientific credibility. Because of their high standing in the community of risk assessors, their experience in explaining difficult technical issues, and their understanding of the social contexts in which risk assessments are used, ENVIRON's senior scientists offer clients unsurpassed opportunities for successful risk communication.

- determining the validity of claims of causation
- distinguishing the type of risk assessment used in the regulatory context from that needed to establish medical causation
- evaluating the need for and value of medical monitoring
- conducting/reviewing epidemiology studies in plaintiff populations
- analyzing alternative causation theories
- providing expert testimony in matters of toxicology, exposure and risk assessment, comparative risk analysis, and causation
- selecting and preparing expert witnesses

Occupational Health and Safety

ENVIRON has helped a variety of clients find innovative answers to compelling occupational health and safety issues. We have prepared assessments of epidemiological, toxicological, and industrial hygiene data for a variety of chemicals as part of the standards setting and evaluation process for public and private sector clients. We have provided assistance to our clients in their efforts to develop workplace exposure standards and evaluate the significance of occupational exposure risks to worker health and safety.

Anticipating Risks

While occupational health and safety should be critical factors in determining the desirability of a business or location, these criteria are frequently not addressed until it is too late. ENVIRON, however, in the course of performing merger and acquisition due diligence, has examined the occupational health and safety practices of thousands of facilities. We have identified potential occupational health and safety risks and advised hundreds of clients on the prudence of their prospective acquisition.

Evaluating Risks

ENVIRON has earned an international reputation for high-quality scientific assessments of occupational health and safety exposure issues. We have successfully prepared and presented testimony to occupational health and safety regulatory agencies, including:

- presenting expert testimony at the Occupational Safety and Health Administration (OSHA) hearing on inorganic arsenic on behalf of a trade association client
- assisting a manufacturer effectively respond to a proposed revision to the OSHA respiratory protection standard

We also:

- review internal guidelines and requirements
- evaluate program structure
- design statistically based, legally defensible employee exposure assessment programs
- provide technical support for clients in a variety of industries

ENVIRON has developed the Strategic Employee Exposure Assessment Planning and Tracking (SEEAPT™) process for clients who engage us to design their exposure assessment programs. SEEAPT™ combines professional judgment and statistical analysis to help decision makers gain the strategic information needed to evaluate key financial, legal, and technical employee exposure assessment issues.

- critical reviews of safety and efficacy data from clinical and preclinical studies
- design of both preclinical and clinical studies
- representing clients before advisory panels and FDA staff

Food Safety

Our food safety practice covers all aspects of production, from raw agricultural commodities and
specific ingredients to processing and safety evaluations of finished products, including:

- developing health risk assessment and regulatory compliance strategies for testing new direct and indirect food additives
- evaluating toxicity test data to support safety determinations
- preparing Generally Recognized as Safe (GRAS) reviews
- developing direct food additive petitions
- preparing exposure and risk assessments for food and environmental contaminants
- clinical and toxicological testing design, placement, monitoring, and submission

Consumer Products

ENVIRON conducts exposure and risk assessments on chemical constituents present in a variety of consumer products, including paints, varnishes, and stains; household cleaning products; and personal health care and hygiene products. We assist clients in:

- responding to regulatory concerns raised by the USEPA or FDA
- addressing state requirements related to consumer exposure to potentially toxic constituents, such as California's Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65)
- assessing and addressing potential environmental impacts of their manufacturing processes

Site Investigation

ENVIRON has extensive experience in developing and implementing comprehensive site investigations under Federal, state, and local statutes, including:

- CERCLA
- RCRA
- TSCA
- Clean Water Act
- Clean Air Act
- State Programs, from New Jersey's ISRA to California's Porter-Cologne Program

Our full spectrum of services includes all activities required to:

- satisfy compliance requirements
- identify environmental liabilities
- assess risk and establish appropriate site clean-up levels
- facilitate the design of efficient engineered systems to reduce chemical concentrations
- to acceptable levels

ities and residual risks associated with potential remedies. We are recognized leaders in applying innovative approaches to projects where a detailed, site-specific analysis is warranted.

- **Remedy Selection**, which includes evaluating the site-specific implementability and effectiveness of potential remedial technologies. When appropriate, we develop laboratory or small-scale field treatability studies to quantify the ability of treatment technologies to achieve cleanup goals. We can also identify potential exposure routes and calculate ecological and health risk levels for both baseline conditions and activities associated with remedy implementation.

- **Remedial Design** when a remedial approach has been developed with adequate detail to confirm appropriateness for the site. Our engineers can develop concise drawings, specifications, and work plans for remediation activities in a format consistent with our clients' standards for contracting. When a potentially inappropriate or unproven remedy has been selected, ENVIRON can conduct a predesign study of the uncertainties associated with implementability or effectiveness.

- **Contractor Selection and Implementation**, which includes working with clients to solicit and evaluate bids from qualified remediation contractors; objectively reviewing contractor proposals; and recommending the contractor who meets project requirements most cost-effectively. Our field oversight services range from functioning as the full-time resident engineer, to occasional field visits, to trouble-shooting implementation problems or developing design alternatives to respond to unanticipated conditions.

- **Risk Communication** with affected communities, particularly about risk and risk mitigation, which can be crucial to adoption of the recommended remedy and to a project's success. ENVIRON's ability to synthesize and communicate the associated technical, economic, and policy issues to nontechnical audiences has earned us a record of success in representing clients before the public.

Strategic Environmental Management

The pendulum has swung back. After two decades of promoting environmental, health and safety management (EH&S) as a business function carved out of the organization and treated in a vacuum, corporations operating in a competitive international marketplace have come to realize that EH&S must be integrated into overall business strategy. Companies must have an environmental strategy to stay competitive both domestically and internationally, while remaining in compliance with regulations and international standards.

Different Risks, Different Needs, Different Strategies

Environmental issues require analysis that meets the organization's need to minimize risks and liabilities within the corporate culture. To achieve this, ENVIRON helps our clients to implement management systems that meet the following goals:

Project Experience

Air Quality

ENVIRON offers a broad range of air quality services providing clients with strategic assistance in:

- identification of critical regulatory requirements
- quantification of emissions (including process analysis)
- modeling of air concentrations (indoor, local, urban, and regional scale) resulting from transport, dispersion, and chemical transformation of that material
- assessment of people's exposure to airborne material
- design of meteorological and air quality data-gathering networks and analysis of those data
- technological and process means to reduce emissions

ENVIRON's air quality staff are recognized nationally for their expertise in all aspects of air quality services, including air toxics, air dispersion modeling, exposure assessment, emissions inventories, atmospheric fate and transport (including photochemically reactive substances), indoor air quality, and meteorological and air quality data analysis.

Following are selected examples of ENVIRON's air quality project experience.

- Our staff members are principal developers or co-developers of a range of innovative, state-of-the-art air quality, population, exposure, indoor air quality, and multimedia risk models. These models have been used in numerous air toxics and criteria pollutant analyses performed to address risk-based new source permitting rules and state and local statutes like California's AB 2588 (Air Toxics Hot-Spot Program) and Proposition 65.

- ENVIRON developed and applied a Monte Carlo air toxics exposure assessment model for three national industrial trade organizations. By considering activity patterns, indoor-outdoor differences, residency duration, and other sources of variability, the model obtains more realistic results than do standard regulatory methods. A case-study analysis of exposure to fugitive benzene from leaking equipment at a large chemical plant demonstrated that Monte Carlo-determined exposure was less than exposure determined by standard regulatory methods by a factor of up to 18.

- As part of negotiating a reasonable compliance program for a chemical facility, ENVIRON compared the photochemical reactivity of ethanol with other volatile organic compounds (VOCs), and evaluated the effect of reducing the facility's ethanol emissions on the ozone concentrations in the nonattainment area.

- To satisfy requirements of California's Air Toxics Hot Spots Program, a major electric utility retained ENVIRON to perform air dispersion, exposure, and health risk assessments for ten power plants in Southern California. The work involved emission characterization, air dispersion modeling, population exposure calculation, and multipathway cancer and noncancer health risk assessment.

- For a major agricultural trade organization in Hawaii, ENVIRON estimated field emissions, air concentrations, and population exposure to air emissions from field fumigation operations. The work supported the trade organization's submittal in regulatory proceedings.

- For a New Jersey producer of coated metal products and photochemicals, ENVIRON implemented a multiphase, comprehensive air emissions compliance program. A major focus of the work was to develop air permit applications for new and modified sources and processes. Efforts included implementing a source testing program, developing an atmospheric dispersion model for the facility, and analyzing the potential off-site human health risks associated with selected critical emission sources.

- ENVIRON critiqued the North Carolina Environmental Management Commission's proposed regulations for controlling air toxics emissions from incinerators. The assessment included dispersion modeling using assumed and actual incinerators and stack parameters assumed by the State. By comparing these calculated ambient impacts to the proposed State acceptable ambient concentrations, we concluded that the proposed standards would require a degree of control beyond what was necessary to protect human health. We submitted our analysis during the public comment period.

- ENVIRON completed a facility-wide emission inventory for an industrial coating facility that provides a variety of coating formulas for a series of short-term batch operations. We inventoried the range of coating formulas and associated emissions to prepare a comprehensive emissions inventory for the facility. Emissions were determined using engineering, chemical process, and mass balance calculations.

- In response to the requirements of SARA Title III, Section 313, ENVIRON prepared emissions inventories for a facility manufacturing coatings and photo processing products and for a facility manufacturing dyes, pigments, and pharmaceuticals. The work included developing an air emissions inventory, performing dispersion modeling, assisting with permits and compliance issues, and developing a risk assessment based on the predicted fenceline concentrations.

- The Ontario Waste Management Corporation (OWMC) retained ENVIRON to assist in its effort to site a new hazardous waste incineration facility. We developed a detailed risk assessment that evaluated public health and environmental impacts from exposure to pollutants projected to be released from the facility. The risk assessment considered both atmospheric emissions and ash produced by the facility, as well as releases resulting from upsets and accidents.

- ENVIRON completed a comprehensive air permitting program for a New Jersey producer of bulk and photo-resistant chemicals. The program involved updating the facility's air emissions inventory, completing air permit applications for existing sources, documenting current and projected emissions and analyzing their potential impact, and completing associated air permit applications.

- ENVIRON has conducted hundreds of environmental audits of industrial facilities. Auditing procedures include analysis of air emissions and air exposure pathways at each audited facility. At some facilities, particularly in sensitive areas like California's South Coast Air Quality Management District, we have provided guidance for administrative and/or process changes to ensure compliance with VOC emissions regulations.

- ENVIRON evaluated exposures in an indoor environment for several clients in response to California's Proposition 65. Emission rates of carcinogens or reproductive toxins were developed based on mathematical modeling or laboratory measurements. Products evaluated were in the form of aqueous solutions, aerosols, insulation, waxes, sheets, and powders.

- An aircraft manufacturer retained ENVIRON to evaluate the human health risks associated with the inhalation of volatile organic compounds. A landfill on the manufacturer's property had ground water contaminated with several organic solvents (VOCs), of which the following were present in the highest concentrations: cis-2dichloroethylene, vinyl chloride, trichloroethylene, 1,1-di-chloroethane, 1,1dichloroethylene, and benzene. Five engineering systems were proposed to remove the VOCs from the ground water. ENVIRON estimated air concentrations, population exposure, and adverse health risks from VOC releases associated with each alternative.

- ENVIRON evaluated potential emissions and exposures resulting from the use of toxic chemicals in the manufacture of superabsorbent fibers. We considered potential emissions resulting from the manufacturing process, the filling and continuous sparging of storage tanks, and storage tank rupture.

- ENVIRON provided technical support and expert testimony in litigation in Kentucky and Massachusetts involving alleged adverse health effects resulting from inhalation of toxic vapors from an improperly filled fuel tank and from leaking underground storage tanks.

- For a hazardous waste landfill in California, ENVIRON estimated the impacts of volatile emissions on downwind populations. Land and sea breezes, and diurnal upslope/downslope conditions resulted in elevated concentrations of volatiles such as vinyl chloride in the site vicinity.

ranking procedure to prioritize sites for further characterization based on known hydrogeologic conditions and steps to evaluate the cost-effectiveness of the characterization process.

- ENVIRON used decision tree analysis to help an automobile manufacturer determine the optimum decommissioning strategy for a vacant 2-million-square-foot manufacturing facility contaminated with PCBs. Soil and ground water contamination were also present at the facility, but with limited characterization data. Options evaluated included demolition and remediation of environmental contamination; reuse with deferral of environmental remediation; and containment, also with deferral of environmental remediation. The decision analysis, which considered both total cost outlay and timing of cash flow, identified demolition as the preferred option.

- ENVIRON used decision tree analysis to assist a major chemical manufacturer in determining the future use of an outdated working chemical production facility. Two of the options considered were: 1) renovation and reuse as either an industrial or residential property, with attendant enviromental remediation costs; and 2) continued use of part of the facility for production, with the opportunity to defer some environmental remediation costs. Because the facility was outdated, production costs associated with the latter option would be higher than those incurred if the facility were updated.

- On behalf of a PRP at a Superfund site involving dredging of contaminated sediments, ENVIRON used decision tree analysis to determine the preferred strategy for responding to an expensive remedy selected by USEPA in a Record of Decision (ROD). The options considered by the client included prevailing on USEPA to select an alternative remedy through litigation of the ROD; allowing the agency to proceed with the implementation and paying their assigned share; and implementing the selected remedy themselves with the application of value engineering to reduce costs. The results of the analysis suggested that the latter course would result in the best chance for limiting costs at the site.

- For a property transaction, ENVIRON used decision tree analysis to assist a buyer in negotiating a fair price for a contaminated industrial property. The analysis was used to interpret the limited site characterization data so that an expected value for site remediation costs could be clearly presented. The analysis also explicitly displayed the upper and lower bounds of the remediation costs.

- ENVIRON developed a decision model for ranking the hazard potential of a number of different manufacturing sites owned by a large conglomerate. The model was based on the types and quantities of substances handled by the facilities, focusing on the most significant effects of accidents. Both sudden and non-sudden events were considered. Important factors were the characteristics of the substances being used; the surrounding population at various distances from the facilities; and the release potential of the chemicals.

Asbestos

Asbestos is a ubiquitous contaminant with potential adverse health effects that have been the focus of intense regulatory and public concern. Despite the close scrutiny to which these health effects have been subjected, there still remains much uncertainty and controversy over many important issues related to asbestos exposure and risk.

ENVIRON provides a range of services for determining the potential human health risks associated with asbestos exposure, and for interpreting and complying with regulatory requirements for its management and removal. We can assess the degree of risk associated with specific occupational and environmental asbestos exposures, review and recommend procedures for protecting the health and safety of asbestos-exposed workers, develop plans for asbestos identification and removal, and assist in developing overall asbestos management programs. ENVIRON also provides expert litigation support in cases involving health or property damage due to asbestos exposure.

Following are selected ENVIRON projects involving asbestos exposure assessment and management:

- ENVIRON analyzed measurements of asbestos fibers in workplace air to demonstrate that removal of asbestos-containing floor tile did not produce exposures above occupational standards. We also designed, conducted, and analyzed similar exposure studies for removing sheet vinyl flooring with asbestos underlayment and asbestos-containing tile adhesives. A third series of studies examined exposures to workers who maintain resilient floor tiles containing asbestos. Based on this data, we assisted floor material manufacturers in complying with Occupational Safety and Health Administration (OSHA) standards for worker protection.

- For a tire manufacturing company, ENVIRON investigated the nature of the risks to employees, who experienced up to 10 years of asbestos exposure during the 1960s. We also advised the company on the requirements for and possible benefits of notifying employees of the past exposure.

- ENVIRON has assessed the nature and extent of asbestos materials in hundreds of commercial, residential, and industrial buildings, and has recommended appropriate responsive actions when necessary.

- For a major law firm, ENVIRON prepared written comments on USEPA's proposed rule for controlling asbestos exposure in schools. The comments focused on the advantages of sampling air for fibers as a method to measure exposures.

- ENVIRON has assisted in defending a variety of manufacturers, trade associations, and other defendants in lawsuits alleging health and property damage due to past asbestos disposal practices. ENVIRON provided expert testimony and litigation support on asbestos risks, including a literature review on dose-response for asbestos-related diseases, an analysis of alternative causes for respiratory diseases allegedly caused by asbestos exposure, and a review of plant-specific industrial hygiene data.

Biotechnology

Background and Issues

ENVIRON is an established leader in identifying and characterizing potential risks associated with commercial applications of the emerging discipline of biotechnology.

The products of biotechnology fall into at least three regulatory categories: foods, pesticides, and drugs and biologics. The variety of regulatory issues that must be addressed for each product category depend largely on whether the end product is a purified substance (e.g., drug, biologic, applied pesticide, or simple food additive), in which case the genetic identity of the producing organism is of lesser consequence, or a product to be consumed entirely (e.g., foods and transgenic pesticidal crop plants), in which case the entire process must be evaluated.

Although the responsible agencies maintain that regulatory approval is product and not process driven, safety approval, in fact, depends on demonstrating that the generating process does not adversely affect the end product or its use.

By working within the existing framework of regulatory approval, creating new conceptual approaches to risk assessment, and educating concerned parties to dispel apprehensions about this exciting and powerful technology, ENVIRON has been instrumental in helping clients handle the technical aspects of the regulatory process for these new products. ENVIRON has been involved for many years in the technical aspects of food, drug, and pesticide approvals. The firm's substantial expertise in microbiology, molecular biology, and biotechnology, added to its traditional skills in toxicology and risk assessment, place ENVIRON at the forefront of biotechnology risk assessment.

Risk Perception, Education, and the New Technologies

- ENVIRON was requested to participate in a joint U.S./U.S.S.R. international workshop, sponsored by USDA/NBIAP, to identify and characterize uses for biotechnology in integrated pest management.

- For a consortium of venture capital investors from the Pacific Rim, ENVIRON was asked to prepare a statement on costs and regulatory issues involved in taking new biotechnology and genetic engineering products from the laboratory to successful commercial ventures.

- ENVIRON organized a workshop for a professional society of scientists on approaches to determining the safety of biotechnology products. Included were presentations by ENVIRON staff members on "Characterizing the Risks Associated with the Products of Biotechnology," and "Animal Testing for the Products of Biotechnology."

- ENVIRON gave the keynote lecture and technical presentations for the Australian Society for Clinical and Experimental Pharmacologists and Toxicologists.

Scientific Issues and Regulatory Submissions

- ENVIRON prepared a Master File submission to FDA for a biotechnology company to assess the safety of antibiotic resistance marker genes used in genetically engineered crop products. The first of its kind, this submission provided a generic framework on

Dioxins and Furans

Dioxins and furans (2,3,7,8-tetrachlorodibenzo-p-dioxin and its related compounds), some of the most highly toxic and persistent chemicals ever tested, bioaccumulate in fish, livestock, and human tissues. Individuals exposed to dioxin have filed lawsuits alleging a myriad of adverse health effects. As a result, potential sources of dioxins and furans in the environment, including incinerators, bleached paper products, and certain herbicides, have been subjected to increasing scrutiny by both regulatory agencies and the public. ENVIRON has been involved in many projects to evaluate the potential human health risks posed by exposure to dioxins and furans. Selected project experience is described below.

- In 1989 and 1990, numerous state governments proposed ambient water quality standards for a variety of chemical substances to meet the requirements of the 1986 amendments to the Federal Clean Water Act. Setting water quality standards for dioxin proved controversial because the water quality criteria published in 1984 by the U.S. Environmental Protection Agency (USEPA) were very stringent. If adopted as standards, those criteria would have resulted in permit restrictions on dischargers that were burdensome, if not impossible, to meet. Paper mills manufacturing bleached pulp were especially vulnerable, and sought ENVIRON's assistance in understanding the health risks posed by dioxin mediated through consumption of fish and water from affected streams. ENVIRON found that some of the conservative assumptions used in the USEPA criteria document were unnecessary in light of information developed about dioxin in the 1980s; a water quality standard approximately 100 times less stringent than that suggested by USEPA was therefore recommended. ENVIRON then assisted a variety of paper companies in presenting that information to state regulatory agencies and legislatures. As a result, several states adopted the standard recommended by ENVIRON.

- Dioxin may be found in a variety of products made from bleached pulp. To assess concerns about potential health effects from use of these products, USEPA, the Food and Drug Admin-istration (FDA), and the Consumer Product Safety Commission joined forces in 1989 and 1990 to conduct an integrated risk assessment of all exposures to dioxin resulting from production and use of bleached pulp. The research arm of the paper industry, the National Council for Air and Stream Improvement (NCASI), agreed to help the agencies by supplying estimates of dioxin concentrations and exposures. NCASI asked ENVIRON to develop these estimates for food packing, other food contact items, direct food additives, and medical devices.

- ENVIRON assisted several companies that manufacture personal care paper products in estimating the risks of using products manufactured with bleached pulp. ENVIRON calculated the concentrations in pulp that would produce various acceptable risk levels under different assumptions about dioxin's carcinogenic potency. ENVIRON assisted one company in presenting these results to the Consumer Product Safety Commission.

- ENVIRON prepared a report in relatively nontechnical terms on the complex subject of assessing human exposure to environmental agents. The report presented a detailed exposure assessment of dioxin as an example. Sources of dioxin in the environment

Ecotoxicology and Ecological Risk Assessment

Ecotoxicology is the study of the adverse effects of chemical substances on aquatic and terrestrial life forms. Ecological risk assessment is the process by which ecotoxicologists identify real or potential ecological risks posed by a particular substance (e.g., a chemical, product, discharge, or hazardous waste) or activity (e.g., site remediation or packaging processes). These assessments require expertise in several disciplines, including ecology, toxicology, chemistry, engineering, modeling, and risk assessment.

ENVIRON's broad-based expertise in these disciplines is enhanced by the firm's well-established relationships with both state-of-the-art testing facilities here and overseas, and with the regulatory agencies (e.g., USEPA and FDA) responsible for protocol approvals and submission reviews. In fact, ENVIRON has been involved in developing the techniques used by USEPA and others in conducting ecological risk assessments.

ENVIRON has assessed ecological risks associated with a wide variety of new and existing chemicals, products, packaging materials, and processes; with contaminated aquatic and terrestrial sites; and with remediation of contaminated sites. The following projects are representative of work completed to date in this rapidly expanding practice area.

- ENVIRON developed environmental impact reporting criteria and protocols, and assisted in auditing facilities and developing impact assessments for clients involved in the U.S. USEPA Toxic Substances Control Act, Section 8(e) Compliance Audit Program. Clients included a multinational gas, oil, and coal manufacturer, and a multinational industrial chemicals and commercial materials company. Assessments covered air, water, soil, and ground water contamination.

- ENVIRON assembled a team of experts and provided oversight and technical expertise in the critical review of a National Oceanic and Atmospheric Administration (NOAA) Natural Resources Damage Assessment-Injury Determination Plan. The plan provided guidance for assessing priority pollutant contamination of a harbor, estuary, and open ocean site. Resource evaluations included water quality, fisheries, seabirds, and marine mammals.

- ENVIRON conducted environmental impact/risk assessments for chlorinated organics at numerous compressor station sites along a transcontinental natural gas pipeline. The assessment approaches were tailored to meet the different state and/or USEPA region guidelines. A key component of each assessment was the potential for food chain exposures of fish and fish-eating wildlife. Both water and sediment routes were examined.
- ENVIRON prepared an environmental analysis to contrast the overall environmental compatibilities of ethanol-based and chlorine-based disinfectants used in the home. Environmental fate, transport, and potential impacts were evaluated in wastewater, surface water, ground water, and air (both troposphere and stratosphere).

- ENVIRON prepared an ecological risk assessment and follow-up testing strategy for a new micro-encapsulated solvent to evaluate whether residual amounts after treatment would pose an unreasonable risk if released into surface waters. Through a

- ENVIRON evaluated disposal options for dioxin-contaminated sediments to be dredged from an access river for a major northeastern terminal. ENVIRON also assisted in conducting tests designed to measure the potential for dioxins in sediments to bioaccumulate in aquatic organisms.

- ENVIRON examined the hazards to aquatic life that might be associated with formaldehyde discharges from a resin manufacturing plant. The extent to which the plant's NPDES permit might be changed without posing any unreasonable risk to the aquatic ecosystem in the receiving waters was also examined.

- ENVIRON contributed to the development of the RCRA Risk-Cost Analysis Model for USEPA's Office of Solid Waste, a project aimed at identifying cost-effective options for control of hazardous wastes. As part of the development of the ecological risk model, ENVIRON scored more than 80 chemicals based on aquatic and terrestrial toxicities and aesthetic thresholds.

- For a chemical company, ENVIRON coordinated the design of a study investigating bioaccumulation of DDT and other chemicals by fish and other aquatic organisms in the Delaware River.

- At a Superfund site in Pennsylvania, ENVIRON conducted an environmental evaluation that included an ecological survey, wetlands delineation, aquatic toxicity testing in a nearby stream, and a quantitative risk assessment on indicator species in the study area.

- For a chemical company, ENVIRON conducted an environmental risk assessment on a California salt marsh, which included selection of an indicator species, hazard evaluation, indicator chemical concentrations at the receptors, exposure assessment, and risk characterization. Potential risks to endangered species were also quantified.

- In conjunction with a billion-dollar bid for a forest products company, we conducted environmental and health due diligence reviews for facilities including pulp and paper mills, box plants, and a printing product plant.

- ENVIRON has been retained and is on the list of approved contractors of a number of large financial institutions in New York and California, as well as other states, to conduct Phase I environmental assessments of industrial, commercial, and residential properties associated with loan applications, as well as bankruptcies and foreclosures.

- We have completed over 150 assessments of industrial facilities in conjunction with their applications for environmental impairment liability insurance or their decision to self-insure.

- As part of an internal audit program for a major corporation producing noise insulation, fiberglass pipes, and aircraft components, we conducted environmental and occupational health and safety audits of five manufacturing facilities.

- ENVIRON was retained by counsel to a multinational chemical company to conduct environmental compliance and potential Phase I liability assessments of chemical manufacturing operations located in six states We evaluated these operations for compliance with current and future environmental regulations, and estimated the future costs of an ongoing ground water remediation program and environmental compliance.

- ENVIRON performed a Phase I environmental assessment of a steel production and fabrication company with 26 facilities throughout the southeastern United States. The assessment included site visits to all company facilities, which included 6 steel minimills with electric arc furnaces, fifteen steel fabrication facilities, and five other steel manufacturing facilities. We also reviewed files at all pertinent Federal, state, and local regulatory agencies located in ten states and three USEPA regions.

- In conjunction with a possible acquisition, ENVIRON performed a Phase I environmental assessment of a national lawn care company. We visited 25 of the company's 200 U.S. and Canadian facilities; reviewed the company's environmental records, particularly pertaining to past and present underground storage tanks; and assessed potential liabilities associated with past, present and future use of herbicides, pesticides, and other chemicals. We identified costs for removal and possible remediation of underground storage tanks as the most significant potential liability.

- For USEPA, ENVIRON prepared a risk assessment of the Hyde Park Landfill in Niagara Falls. The risk assessment included a series of rankings of the potential hazard of the chemicals by various routes of exposure to determine major toxicants, and the assessment of risks from more than 100 chemicals by more than 10 potential routes of exposure. Both direct and indirect exposure of adults and children were considered; in-depth, site-specific evaluations of major routes of exposure (e.g., local rates of fish consumption) were also conducted. The evaluation included determination of the effects of uncertainties in fish bioaccumulation factors for assessment of risk; design of a study to generate data on the bioconcentration and bioaccumulation factors for 2,3,7,8-tetrachlorodibenzo-p-dioxin; assessment of the effects of incineration of leachate on human health and the environment; assessment of the potential risks from exposure to particulates and vapors if the site were excavated; and an assessment of the health risks to a nearby community from exposures to particulates and volatile air pollutants to be generated during remedial work at the Hyde Park Landfill.

- ENVIRON was retained by an aircraft manufacturer to evaluate the human health risks associated with the inhalation of volatile organic compounds. A landfill on the manufacturer's property had contaminated ground water with several organic solvents, of which the following were in the highest concentration: cis 1,2-dichloroethylene; trans-1,2-dichloroethylene; vinyl chloride.

- For a chemical company, ENVIRON performed a health risk assessment for volatile organic chemical discharges to the Delaware River. These discharges entered the river via contaminated ground water beneath the site. In this assessment, which was presented to and accepted by the New Jersey Department of Environmental Protection, we (1) calculated mass loadings of VOCs to the river based on observed concentrations in the ground water monitoring network; (2) calculated river concentrations of VOCs resulting from these discharges; (3) reviewed the chemical toxicities for these chemicals; (4) identified routes of potential exposure; and (5) performed a health risk assessment. The major human health risks at this site were found to be associated with the ingestion of contaminated river water and fish.

- For a chemical company, ENVIRON investigated pathways by which various organic compounds can be accumulated by fish, including exposures to chemicals in the water column, food, or sediment. Our review indicated that low molecular weight and volatile compounds, such as vinyl chloride, tend to be rapidly metabolized and eliminated by fish. Therefore, the risk associated with ingesting fish exposed to these organic compounds would likely be low.

- For three major U.S. utilities, ENVIRON developed a methodology for evaluating the potential health risks presented by former gasification sites. The methodology included a series of exposure models and risk assessment calculations. Included in the methodology were decision points at which an appropriate model or variable would be selected, depending on site-specific conditions. Predicted exposures were compared to

Food Safety Assessments: Additives, Pesticide Residues, and Contaminants

ENVIRON provides a broad array of scientific, regulatory, and strategic support services for projects involving food safety assessments. In evaluating the variety of risks associated with food safety, we look at more than just consumers' dietary exposures—we also consider environmental exposures resulting from application, processing, packaging, or disposal operations.

We can also assist clients in the design and implementation of quality control procedures and sampling programs that ensure product purity; provide guidance in negotiating USEPA procedures for food additive tolerance approvals for pesticide residues that concentrate during processing; and support the demonstration of *de minimis* carcinogenic risk according to USEPA policy under the Federal Food, Drug and Cosmetic Act's Delaney Clause. ENVIRON has performed California Proposition 65 compliance on dozens of food and beverage products, and provides scientific, technical, and strategic services to support litigation involving pesticide residues.

Following is a representative sampling of ENVIRON's food safety projects.

- A food industry trade association asked ENVIRON to assess the scientific validity of a paper prepared by a public interest group on pesticide risks in children's food.

- ENVIRON developed an approach for assessing potential health and environmental impacts of bioengineered food crops and presented this work to FDA, USEPA, the California Department of Food and Agriculture, and major food and drug law firms.

- ENVIRON was retained to search and analyze scientific literature on background concentrations of lead in food to assist attorneys representing a food company in its effort to comply with California's Proposition 65.

- ENVIRON reviewed the toxicology data on a fungicide used in Europe and performed a cancer risk assessment for illegal residues of the fungicide in wines. Findings were presented to USEPA and FDA. ENVIRON also advised the manufacturer regarding the acceptability of the existing data for purposes of U.S. registration or import tolerance petition.

- ENVIRON prepared a submission to the Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additives (JECFA) on the safety of two nitrofuran animal drugs, furazolidone and nitrofurazone. The work included a novel method for assessing the risks associated with consuming residues of the drugs in meat and poultry, based on pharmacokinetics and metabolism.

- To determine the circumstances of cyanide contamination in grapes, ENVIRON interpreted data, evaluated analytical methods, and recommended additional studies.

- An agricultural products manufacturer requested that ENVIRON evaluate the carcinogenic risk posed by a pesticide metabolite present in edible animal products. ENVIRON

- A major biotechnology company seeking FDA approval of newly engineered food products requested ENVIRON's technical assistance in evaluating all safety data and regulatory issues related to its products. ENVIRON prepared a GRAS affirmation document.

- ENVIRON was asked by a major trade association to review information on the metabolism of a chemical contaminant found in alcoholic beverages. We provided guidance to scientists researching the metabolism of the chemical in the presence of ethanol. ENVIRON also assisted the association's outside legal counsel in evaluating the merits of a petition submitted to FDA by a public interest group.

- ENVIRON prepared an Authority to Construct application for ethylene oxide (EtO) sterilizers for a major food processing company. The application included estimation of off-site air quality impacts.

- ENVIRON critically reviewed USEPA's assessment of dietary oncogenic risks of two fungicides and advised the manufacturers on what additional data were needed to perform a quantitative risk assessment.

- ENVIRON assisted a manufacturer in obtaining FDA approval to expand the uses of its products in foods. We updated an existing review of the toxicological literature on the material and estimated the increase in exposure likely to result from the proposed new uses.

- A major food and beverage manufacturer retained ENVIRON to evaluate the safety of a material proposed for use in a new degreasing agent that required USEPA and FDA clearance.

- ENVIRON prepared a risk assessment of the potential for a compound introduced during the de-hulling process to contaminate rice and its by-products.

information; identified toxicity testing gaps in the safety information; prepared specific protocols for *in vivo* and *in vitro* toxicity tests; and placed and monitored studies at contract laboratories.

- The biotechnology division of a major brewery retained ENVIRON to conduct a critical evaluation of published and unpublished data related to the safety of a novel sugar product for use in animal feed, and to determine the level of the product that could be characterized as GRAS.

- ENVIRON reviewed and evaluated the scientific literature on the safety of a new source of dietary fiber, and assisted the manufacturer in developing a GRAS affirmation petition, which subsequently gained FDA approval for use of the product in food.

- For a major biotechnology company, ENVIRON conducted a GRAS self-affirmation review that included an evaluation of safety data on bioengineered food products. ENVIRON presented the review to FDA on behalf of the client.

- ENVIRON developed a GRAS affirmation document for a cellulose product, manufactured by a novel fermentation process, which was proposed for food use as a suspending/thickening agent. ENVIRON designed, placed, and monitored preclinical toxicity studies required for FDA approval.

- ENVIRON performed ground water modeling studies of the fate and transport of chlorinated solvents and chemical fertilizer releases to determine their potential impact on private and public water supplies at three manufacturing facilities in Nebraska and Iowa.

- ENVIRON developed a system to recover and treat ground water contaminated with nonaqueous-phase chlorinated solvents, oil, and PCBs at an organic chemical manufacturing facility in New Jersey; the work included bench-scale treatability tests and waste treatment process design.

- ENVIRON developed a mathematical model of two-phase flow for a PCB-oil layer floating on the water table to facilitate the design of a remedial action plan at the Kin-Buc landfill in Edison, New Jersey.

- ENVIRON presented expert testimony at trials in Florida regarding the origin and public health impacts of chemical contamination in two large municipal well fields.

- ENVIRON evaluated the performance of ground water and vapor-phase recovery systems, assessed potential public health impacts, and developed on-site monitoring requirements for a 20,000-gallon gasoline spill in a residential area in Fairfax County, Virginia.

- ENVIRON performed site investigations and modeling studies of ground water remediation systems at a phospho-gypsum waste storage pile in central Florida.

- ENVIRON prepared a field investigation at a manufacturing facility in Massachusetts to define the extent of ground water and surface water contamination and identify potential contaminant source areas. The investigation included soil boring and monitoring well construction, chemical analysis, soil gas surveys, aquifer pumping tests, and process design of remedial systems for treatment of chlorinated solvents, heavy metals, and radiological constituents in ground water.

- ENVIRON investigated the potential for and the associated ground water impacts of hydrocarbon leakage from underground storage tanks at a number of manufacturing and petroleum storage and retail sales facilities. Several of these evaluations ultimately resulted in removal of leaking tanks and recovery and treatment of contaminated soil and ground water, for which ENVIRON provided design and construction oversight.

- ENVIRON evaluated the fate and transport of ethylene dibromide (EDB) in ground water in Florida and Washington and assessed its potential impact on public water systems.

Ground Water Modeling

ENVIRON assists clients in understanding the nature of their ground water problems by using computer modeling techniques to assimilate an array of individual data points into an overall picture of ground water conditions at a site. Modeling studies simulate present flow system behavior and future aquifer response to environmental change or engineering intervention. We are also called on in many cases to assess the methods and results of previous modeling investigations.

ENVIRON has pioneered the development of software to enhance hydrogeological investigations. We have developed a user-friendly software program, EFAM™ (ENVIRON Flow Analysis Model), to help clients simulate ground water flow at their own sites.

Our modeling experts have also developed a flexible graphics software package to display inputs and outputs of mathematical models. The FEPER™ (Finite Element Perspective) code may be used in conjunction with both finite element and finite difference models of ground water flow and solute transport. The program is a powerful tool for presenting modeling results in a clear and understandable format for report graphics or courtroom exhibits.

The following selected project summaries highlight ENVIRON's modeling experience.

- ENVIRON developed regional and local three-dimensional mathematical models of ground water flow and solute transport for a Superfund site in New Jersey. The modeling demonstrated that the river adjacent to the site isolates the existing public supply wells from on-site contaminants. Moreover, it identified another Superfund site as a likely source of contaminants found at those wells. The model has since been used in screening a wide variety of remedial alternatives, negotiating the conceptual design of the remedial system with regulatory agencies, and selecting the placement and rates for remedial extraction wells.

- ENVIRON performed ground water modeling studies of the fate and transport of chlorinated solvents and nitrates at three manufacturing facilities in Nebraska and Iowa, and analyzed the potential for impact on residential and public water supplies.

- ENVIRON developed a mathematical model of two-phase flow for a PCB-oil layer floating on the water table at a landfill in New Jersey. The modeling results were used in the remedial action plan to estimate extraction rates for both the oil and water phases.

- On behalf of a Florida city water utility in a case involving contamination of the utility's ground water supply, ENVIRON provided litigation support and expert testimony. Support included quality assurance supervision and technical peer review for ground water flow and contaminant transport modeling associated with cost-recovery litigation. Computer models were used to trace the migration of the volatile organic contaminant from the suspected source to the City's wells and to estimate the time and cost required for remediation of contaminated ground water.

- ENVIRON was involved in the development and presentation of a national series of USEPA-sponsored workshops on Wellhead Protection. The course focused on the use of simple analytical ground water flow models to delineate areas around public water-

Human Drugs and Biologics

ENVIRON assists clients in the pharmaceutical industry in interacting with the Food and Drug Administration (FDA) and in responding to FDA regulations, guidelines, and policies. We have provided guidance and scientific support in all aspects of the regulatory process for drugs and biologics including the following:

- preparing and reviewing data submitted in support of Investigational New Drug (IND) and New Drug Applications (NDAs);
- preparing protocols for animal testing of pharmaceutical products;
- serving as the client's liaison to the FDA technical staff;
- assessing the risk to humans from contaminants and constituents of human drugs;
- evaluating efficacy studies performed on new pharmaceutical products; and
- evaluating animal toxicity data on over-the-counter (OTC) and prescription pharmaceuticals.

Following is a selected list of ENVIRON projects in this area.

- ENVIRON provided guidelines for subchronic testing to evaluate the safety for human use of an allergen desensitizer that was produced by polymerizing the allergen through a glutaraldehyde treatment.

- On a chemical contaminant present in a drug for diabetics, ENVIRON performed a standard risk assessment that included hazard identification, dose-response evaluation, exposure assessment, and risk characterization. After reviewing the data, we recommended a particular study to establish a reliable estimate of cancer risk from lifetime exposure to the contaminant.

- We critically evaluated both published and unpublished studies on a psychoactive drug and rendered an opinion to our client on the drug's potential health effects and on whether a no-observed-effect level had been established.

- For a major trade association, ENVIRON evaluated the potential risks to humans of an OTC medication that is applied to the skin. Because the agent had been found potentially to promote skin tumors in mice, FDA had raised the possibility that the medication could pose a risk to humans. We assessed the issue and prepared a report for submission to FDA.

- For legal counsel to a pharmaceutical manufacturer, we performed an independent evaluation of a New Drug Application (NDA) submission to FDA, with particular emphasis on review of efficacy studies.

- ENVIRON prepared and submitted to FDA an Investigational New Drug Application (IND) for a European pharmaceutical firm. The drug had shown promise for dramatically decreasing the common occurrence of reocclusion among angioplasty patients.

- In support of a clinical trial, ENVIRON reviewed and evaluated the toxicity of a tryptophan for a major pharmaceutical manufacturer to present to FDA.

Industrial and Hazardous Waste Exposure Assessment

Determining whether chemicals or other substances in the environment pose human health risks requires a thorough understanding not only of chemical toxicity, but also of the nature and magnitude of chemical exposure and of exposure mechanisms. ENVIRON has been a leader in developing the practice of exposure assessment and in integrating exposure assessment into the comprehensive process of assessing risks associated with the presence of hazardous substances in the environment. ENVIRON's professional staff includes exposure analysis specialists who have pioneered the development and application of new models and methods for determining exposure in all environmental media. In many cases, chemicals move through several media before human exposure occurs. ENVIRON has been at the forefront of developing multimedia pathway analyses for these situations.

In addition to developing customized exposure assessments for specific circumstances, our staff has conducted hundreds of assessments using standardized techniques, such as those in USEPA's Risk Assessment Guidance for Superfund and California's Scientific and Technical Standards for Hazard-ous Waste Sites. ENVIRON specialists have also developed new methods for general application.

Following is a selected list of ENVIRON projects involving hazardous substance exposure assessments.

- For the Ontario Waste Management Corporation, ENVIRON conducted a comprehensive analysis of the potential risks to human health, domestic animals, and wildlife from a proposed hazardous waste treatment facility. Numerous potential pathways, including the ingestion of crops and meat products that had been affected by the deposition of airborne chemicals, were included in the risk assessment.

- At the request of a hazardous waste management company, ENVIRON prepared an Exposure Target Report for a large hazardous waste disposal site in New York State. The report, prepared to comply with a consent order issued by USEPA, identified and described the human populations and environmental systems susceptible to contaminant exposure from the facility, identifying the demographics of adjacent populations, the location of sensitive subpopulations, the uses of adjacent land, the local terrestrial and aquatic ecology, and the uses and availability of ground water and surface water resources. The report also evaluated the potential for significant exposure of the human and ecological populations identified.

- ENVIRON conducted a health risk assessment of a former uranium mill site where nearby residents were potentially exposed to radionuclides and chemical substances in ground water, air, surface soils, and foods. Past disposal of tailings and other mill residues resulted in off-site contamination of these media. Comparing exposures to mill-derived substances and to naturally occurring levels of the same substances was key to understanding the significance of the exposure levels. ENVIRON evaluated the benefits of a remedial action plan by projecting future exposures based both on remediation and on no action.

absorption within a factor of 3. Based on the octanol/water partition coefficient, estimates of the skin area exposed, the duration of contact, and the concentration of the chemical in the water, the equation made it possible for staff to predict exposures from environmental chemicals in bath water, swimming pools, and natural surface waters.

- As a general tool for predicting contaminant migration in ground water, ENVIRON developed EFAM™ (ENVIRON Flow Analysis Model), a graphical computer program that enables an analyst to display ground water flow patterns and extraction well capture zones. The program makes possible the efficient testing of various remediation strategies without major modifications to the computer program for each run. EFAM can also be used in exposure assessments to identify water supply wells that are likely to be affected by known sources of contamination.

- For USEPA, ENVIRON prepared a risk assessment of a Superfund site in New York. The risk assessment included a series of hazard rankings to determine the major toxicants and to assess risks for more than 100 chemicals by more than 10 potential routes of exposure. Site-specific assumptions (e.g., local rate of fish consumption) were used to develop estimates for both adults and children. ENVIRON determined the effects of uncertainties in fish bioaccumulation factors, designed a study to generate data on the bioconcentration and bioaccumulation factors for 2,3,7,8-tetrachlorodibenzo-p-dioxin in fish, assessed the effects on human health and the environment of incinerating leachate, and assessed the potential risks both to workers and the nearby community of exposure to particulates and volatile air pollutants during excavation.

- ENVIRON provided support to USEPA in its promulgation of effluent guidelines for the organic chemical, pesticide, and synthetic fibers industries. Work included developing toxicity profiles, developing alternative subcategorization schemes, and developing a methodology for calculating effluent limitations and standards.

- ENVIRON senior staff pioneered the development of risk assessment techniques in the early 1980s and continue to research the use of new techniques, such as Monte Carlo simulations, to provide more scientifically supportable estimates of exposure.

  In a risk assessment conducted as part of a RCRA corrective action for a site along the Delaware River in Pennsylvania, ENVIRON used a Monte Carlo simulation to provide both reasonable maximum and best estimate predictions of potential risk. The simulation assigned a probability range rather than single point estimates for the exposure factors in the risk calculation, resulting in a probability distribution of risk. The risk assessment was instrumental in persuading USEPA to accept the remedial strategy, which likely would not have been the outcome had standard USEPA methodology been used.

- For a chemical company, ENVIRON performed a health risk assessment for volatile organic chemical (VOC) discharges to the Delaware River. The discharges entered the river via contaminated ground water beneath the site. In the assessment, which was presented to and accepted by the New Jersey Department of Environmental Protection (NJDEP), ENVIRON (1) calculated mass loadings of VOCs to the river based on observed concentrations in the ground water monitoring network; (2) calculated river concentrations of VOCs resulting from these discharges; (3) reviewed the chemical toxicities for these chemicals; (4) identified routes of potential human exposure; and (5) performed a health risk assessment.

- For three major U.S. utilities, ENVIRON developed a methodology based on exposure models and risk assessment calculations for evaluating the potential health risks posed by former gasification sites. The methodology involved identifying critical decision points at which an appropriate model or variable should be selected to reflect site-specific conditions. Predicted exposures were compared to risk-based reference doses,

- ENVIRON has conducted numerous environmental safety assessments of consumer products, such as garbage disposer bags and packaging materials. The assessments have addressed the potential for adverse environmental and public health effects associated with the use and disposal of single-use products and materials. The fate of consumer materials in landfills, incinerators, and waste composting facilities has been evaluated.

- For a major petroleum company, ENVIRON evaluated the risks associated with the operation of a proposed on-site hazardous waste incinerator. We also prepared an assessment of the liabilities associated with several business options involving hazardous waste incineration and an analysis of the future market for hazardous waste incinerators.

- ENVIRON analyzed proposed Connecticut regulations regarding municipal solid waste incinerators for the Connecticut Conference of Municipalities. The work included a detailed analysis of issues related to air pollution standards and testing of incineration residues like fly ash and bottom ash.

- At a major hazardous waste site in the Southwest, ENVIRON evaluated the potential human health impact of incinerating a complex mixture of organic and inorganic chemicals on-site. Site-specific models were applied to examine risks posed by inhalation of airborne contaminants and ingestion of fish and locally grown produce. Incineration risks were compared to those associated with other remedial technologies as part of the overall analysis of potential remedial alternatives.

- ENVIRON was retained by a multinational, European-based corporation to evaluate the technical capabilities and market strength of a contractor who designs, fabricates, and constructs waste incineration systems.

- A citizens' group in Louisiana retained ENVIRON to assist in evaluating the proposed design and operation of a RCRA incinerator. We provided expert opinions on a series of questions prepared by community groups regarding the potential risks posed by the incinerator.

- ENVIRON assisted a PRP group at a Superfund site in evaluating the human health risks posed by incineration of arsenic-contaminated material. Maximum individual risks, "best estimate" individual risks, and overall population risks were estimated.

- We provided technical support to a major Pennsylvania gasoline company involved in a suit brought by citizens exposed to gasoline in their home, which had resulted from a pipeline break.

- On behalf of a major Baltimore-based research institution, ENVIRON provided expert testimony in a suit brought by individuals alleging to have suffered harm from improperly disposed solvents.

- ENVIRON provided litigation support to a dye manufacturer who had been sued by workers claiming to have developed cancer as a result of occupational exposures.

- We have provided expert testimony in numerous administrative hearings on a variety of compounds, including arsenic, PCBs, dioxins, and EDB.

- ENVIRON provided technical support, strategic counsel, and both toxicological and engineering deposition testimony on behalf of a housing developer sued by residents of a Houston subdivision situated next to a Superfund site.

- ENVIRON provided technical assistance to attorneys representing residents who had been exposed to contaminated ground water while living near the New Jersey Jackson Township landfill from 1973 to 1978. We assessed the impact of chemical exposures on the health effects observed in the exposed population and presented these findings as expert testimony in court.

- ENVIRON assessed the nature and extent of chemical pollution resulting from the improper disposal of hazardous wastes at the Woburn, Massachusetts, Superfund site. Human exposure to the chemicals was assessed and health damage claims were evaluated. We also provided expert testimony on state-of-the-art engineering practices.

- ENVIRON provided extensive litigation support to attorneys representing the defendant in the first court case in which a plaintiff alleged the development of "fetal alcohol syndrome." Our litigation support included conducting a critical review of the extensive toxicological and epidemiological data on the health effects of alcohol, developing general strategic papers detailing the strengths and weaknesses of the available data, identifying expert witnesses and examining physicians, developing deposition questions, reviewing medical records, and reviewing data on alternative causes of the plaintiff's alleged health effects.

- For an insurance company, ENVIRON conducted a review of state-of-the-art hazardous waste disposal practices between the 1950s and early 1970s and conducted a historical review of toxicological data for constituents of primary concern at a disposal site. ENVIRON senior staff testified as expert witnesses at trial.

Occupational Health

ENVIRON has prepared assessments of epidemiological, toxicological, and industrial hygiene data for a variety of chemicals to assist the Occupational Safety and Health Administration (OSHA) and major trade associations in the development of occupational health standards. We have assisted corporations in developing workplace standards and provided evaluations of whether occupational exposures present significant risks to workers.

Following are selected summaries of ENVIRON projects involving occupational health.

- ENVIRON prepared and presented expert testimony at the OSHA hearings on the inorganic arsenic standard. ENVIRON reviewed comments on the proposed standard and prepared a detailed assessment of risks associated with occupational exposures.

- For a major industry trade association, ENVIRON provided technical assistance and expert testimony regarding the occupational exposures and risks of benzene and assisted the association in a hearing before OSHA.

- ENVIRON assessed the carcinogenicity of manufactured carbon blacks and presented its findings to OSHA in support of an industry request to reconsider the classification of carbon black as listed in the OSHA Industrial Hygiene Field Manual.

- ENVIRON provided technical assistance to OSHA in analyzing the administrative record concerning occupational exposures to asbestos. Specifically, we identified and analyzed all relevant issues raised by the proposed revisions to the asbestos standard; assessed methodologies to quantify the risk and the potential for risk reduction arising from regulatory action; and compiled, reviewed, and summarized comments and witness statements arising from the asbestos rulemaking.

- ENVIRON assisted major automobile manufacturers in seeking modifications to a variance they had been granted for exposure measurements and medical surveillance requirements stipulated by the OSHA arsenic standard, and to a variance for requirements stipulated by the OSHA lead standard.

- For a major trade association, ENVIRON reviewed and provided comments on OSHA's approach to formaldehyde risk assessment and offered alternative risk assessment methodologies.

- ENVIRON assisted a manufacturer of respiratory protective devices in responding to a proposed revision to the OSHA standard for respirators.

- ENVIRON prepared an analysis comparing risks from an assumed level and duration of occupational asbestos exposure to a number of generally accepted risks in occupational and environmental settings.

- ENVIRON reviewed and evaluated OSHA's asbestos risk assessment prior to its use in the Agency's asbestos rulemaking.

- For a major manufacturer of household products, ENVIRON derived no-significant-risk levels for numerous chemicals and conducted exposure assessments for more than 20 products containing those chemicals. No-significant-risk levels were compared to specific regulatory levels developed by California for some chemicals. ENVIRON presented some of the derived levels as alternatives to those established by the State.

- ENVIRON furnished information to a major trade association on occurrences of numerous carcinogens and reproductive toxicants found in a variety of raw commodities and processed food products.

- For a major national trade association, ENVIRON critiqued the rationale for listing a class of compound as reproductive/developmental toxicants, and derived no-observable-effect levels for several compounds in the class.

- ENVIRON analyzed animal and human data on the reproductive and developmental toxicity of lead, and identified no-observable-adverse-effect levels. These values were used together with assessments of potential lead exposure from a client's products to determine lead concentrations that comply with requirements of the law.

- ENVIRON has organized several activities related to the implementation of Proposition 65. One project examined various methods for determining significant risk for carcinogens, including a review of the relative-risk approach developed by Dr. Bruce Ames of the SAP. ENVIRON has also assisted in developing criteria for listing reproductive and developmental toxicants, and has organized and chaired bimonthly meetings of scientists from food and pharmaceutical industries to exchange information and to identify major issues related to Proposition 65 implementation.

- ENVIRON estimated exposures and cancer risks of individuals exposed to arsenic released during the combustion of fossil fuel. Exposures were estimated for indoor occupational and domestic settings, as well as for industrial emissions into the atmosphere.

- ENVIRON assisted in the development of an environmental sampling plan to support estimates of exposure to polycyclic aromatic hydrocarbons (PAHs) released into an occupational setting and into the atmosphere. ENVIRON also developed exposure and risk estimates associated with these releases.

- ENVIRON provided expert testimony at a hearing of the State Water Resources Control Board on the "point of application of water quality objectives" for surface water and ground water. ENVIRON's testimony highlighted the practical problems and limitations associated with the Board's proposal to monitor for chemicals in pore water in the unsaturated zone.

- ENVIRON conducted a critical review of the multigeneration/reproduction and lifetime studies of a food contaminant. We identified a number of serious deficiencies in the design and metho- dology of the studies, including inadequate numbers of animals per dose group; change of animals from one treatment group to another; failure to ensure random selection of pups; selection of a disproportionate number of pups sired by the same male; the occurrence of sibling matings; the use of replacement animals; the placement of unidentified males in the study; the occurrence of rats escaping from cages; and the development of accidental pregnancies.

- ENVIRON reviewed toxicity and mutagenicity studies on a pesticide, concluding that the pesticide caused a dose-dependent reduction in fertility in rats and mice. We also determined that, because of the likely mechanism of action, the fungicide would not adversely affect human reproduction.

- ENVIRON evaluated the teratogenicity data for a root growth stimulator and estimated a margin of safety for occupational exposure.

- ENVIRON reviewed and analyzed the potential for significant health risks to patients exposed to medical devices with ethylene oxide residues. We reviewed data on reproduction and carcinogenicity, estimated exposures, and compared them with critical toxicologic parameters to determine whether significant health risks were posed by the residues.

- ENVIRON has evaluated data on reproductive and developmental toxicity for TCDD (dioxin), PCBs, and selenium, as integral components of larger projects.

- ENVIRON has prepared detailed on-site hydrogeologic and soils investigations for a large waste recycling and treatment firm, in support of RCRA Part B permits for the firm's treatment, storage, and disposal facilities in South Carolina and California. ENVIRON constructed monitoring wells and soil borings; planned and executed aquifer pumping tests; performed ground water modeling and soil gas investigations; designed and constructed ground water monitoring systems; and gave expert testimony before state and Federal regulatory agencies.

- ENVIRON developed Alternate Concentration Limits (ACLs) for ground water at several industrial facilities in support of RCRA Part B Permitting requirements.

- ENVIRON conducted a detailed investigation at a manufacturing facility in Nebraska to determine the extent of release of VOCs into ground water, and the potential impact on nearby public and private water supplies. Project work included performing ground water quality modeling and health risk analysis.

- ENVIRON assessed the potential environmental and health risks of pesticide residues in soils on former farmland developed for commercial and residential use. ENVIRON's work included assessing the public risks, developing sampling strategies, determining the need for remedial action, and preparing reports to lending institutions, developers, and regulatory agencies.

- For several semiconductor manufacturing facilities in the San Francisco Bay area, ENVIRON has prepared remedial investigations, feasibility studies, endangerment (risk) assessments, and remedial designs.

- At a waste oil refinery in Louisiana, ENVIRON conducted a RCRA Facility Investigation to define the extent of soil and ground water contamination from the prior disposal of still-bottoms and waste residues in unlined pits. This project led to the development of a soil and ground water remediation plan, removal of disposed wastes from pit areas, and construction of a ground water recovery/treatment system. ENVIRON provided full design and construction management services.

- At a petroleum refinery in New Jersey, ENVIRON conducted soil and ground water investi-gations to evaluate impacts from prior and ongoing operations. This project involved the development of a strategic investigative program, negotiation with regula-tory agencies, construction of several hundred monitoring wells, aquifer testing, and ground water and soil sampling/analysis and reporting.

- ENVIRON has conducted over 75 site assessments and remediation programs for underground storage tanks containing gasoline, diesel fuel, and synthetic organic chemicals. These assessments have included tank integrity testing, tank and soil removal, ground water remediation, *in situ* closure, and reporting.

Superfund

ENVIRON has assisted private and public sector clients with analysis, negotiation, and resolution of the complex technical, regulatory, and legal issues addressed by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA). Our work has involved all aspects of site evaluation, remediation, and settlement negotiation, including the following:

- conducting Remedial Investigations/Feasibility Studies (RI/FS) at National Priorities List (NPL) sites;
- preparing environmental and public health risk assessments;
- reviewing and critiquing USEPA Records of Decision (RODs);
- developing cost apportionment schemes as part of settlement negotiations among potentially Responsible Parties (PRPs);
- conducting engineering studies of innovative site remediation technologies;
- providing citizens' groups with technical assistance through USEPA's Technical Assistance Grant (TAG) program;
- offering scientific staff support to the USEPA Office of Policy Development and Office of Solid Waste, and to the Congressional Office of Technology Assessment;
- providing litigation support and expert testimony in engineering, environmental sciences, toxicology, and public health risk assessment; and
- interpreting the requirements of the National Contingency Plan.

Our approach to the evaluation of Superfund sites and to the selection of remedial alternatives differs from many traditional engineering consultants in that our firm's work has been founded on, and is often guided by, a strong scientific basis in health and environmental risk assessment.

ENVIRON has pioneered the use of risk assessment in evaluating remedial options at many NPL sites. In this work, ENVIRON has taken the position that the evaluation of competing remedial alternatives should be based on a defensible scientific analysis of the public health and environmental protection benefits offered by each remedial alternative during and following its implementation. Engineering feasibility, public policy considerations, and costs must also be considered. Such an approach often demonstrates the benefits of innovative remedial solutions from a quantitative health risk perspective.

USEPA recognized ENVIRON's expertise in applying health risk analyses to the Superfund and hazardous waste arena when it retained ENVIRON to prepare agency guidance documents for conducting public health analyses.

Following are selected ENVIRON projects related to Superfund.

- ENVIRON has conducted public health assessments at numerous NPL sites throughout the country where the chemicals of predominant concern were, among others, dioxins, polynuclear aromatic hydrocarbons (PAHs), PCBs, and lead and other heavy metals. These analyses have led to the recommendation of site-specific cleanup levels.

- ENVIRON conducted the remedial design at a Superfund site in Pennsylvania. The design for the $125 million remedy included treatability studies and risk assessments for potentially high arsenic-containing organic wastes, which the ROD requires to be incinerated.

Toxicology and Health Risk Assessment

Since its founding in 1982, ENVIRON has conducted well over 500 different toxicological analyses for projects in a variety of contexts, including litigation; regulatory approval for products such as food additives, pesticides, and pharmaceuticals; and the evaluation of hazardous waste sites.

We have conducted risk assessments on more than 100 specific chemical agents, including carcinogens, developmental toxicants, and systematic toxicants, and at hundreds of contaminated industrial sites.

ENVIRON believes that risk assessment is more than a "cookbook" exercise relying on standard assumptions and models; it requires a thorough understanding of the biological and physical-chemical principles underlying the assessment of toxicology and potential for exposure.

Following are selected ENVIRON projects in these areas.

- ENVIRON has developed toxicity test protocols for numerous clients seeking to market new products, including food additives, pesticides, medical devices, and industrial chemicals. In many cases ENVIRON toxicologists have met with regulatory scientists to negotiate testing needs on behalf of clients. ENVIRON toxicologists have evaluated in-depth the results of a large number and wide variety of toxicity studies. These evaluations have required judgments on the biological and statistical significance of the test results.

- ENVIRON has developed numerous schemes to rank chemicals according to their degree of toxicity. As no single scheme is applicable to all circumstances, specific schemes are tailored to the project objectives.

- ENVIRON has prepared hundreds of literature reviews on human and experimental toxicity, from brief synopses of data to exhaustive critical reviews.

- ENVIRON has participated in projects and in working groups investigating the relative carcinogenic potencies of individual constituents of broad classes of compounds, such as polynuclear aromatic hydrocarbons, PCBs, and dioxins, taking into consideration the available empirical data. The goal of such investigations is a scientifically defensible alternative to the use of a single potency estimate for a wide variety of individual compounds or congeners.

- ENVIRON developed a background document in support of the current USEPA guidelines for cancer risk assessment.

- ENVIRON assisted OSHA by assessing the benefits of alternative approaches to identifying and regulating potential occupational carcinogens, and by developing risk assessment methodologies to be used by OSHA in developing health and safety regulations.

- For a major trade association, ENVIRON prepared a detailed review of the potential health effects of human exposure to polychlorinated biphenyls (PCBs).

- For a major industrial trade association, ENVIRON reviewed the animal carcinogenicity and epidemiological data available on benzene, and assessed its appropriateness for use in carcinogenic risk assessment. ENVIRON also analyzed the various risk assessments which had been conducted on benzene to assist the client in preparing for regulatory proceedings by USEPA and OSHA.

- ENVIRON has assisted attorneys in the assessment of health risks associated with possible benzene contamination of a residential area due to underground leakage of a gasoline storage tank.

- For the defense team of a major defendant in a toxic substance case, ENVIRON organized an extensive scientific and technical data base and developed a series of issue papers on the various forms of toxicity associated with the substance of concern.

- For USEPA, ENVIRON prepared a background document supporting guidelines for risk assessment for reproductive toxicity. The project involved a literature search and analysis of data on all aspects of reproductive toxicity, including developmental toxicity and male and female infertility.

- ENVIRON assisted in developing and analyzing data on a possible contaminant in certain products for a major pharmaceutical company. The project included an assessment of the available reports on product contamination, a review and analysis of the human and animal data on the potential toxic effects of the contaminant, and preparation of a report assessing the potential risks of using the product.

- For the Health Effects Institute, ENVIRON prepared a detailed review and evaluation of the health effects of exposure to gasoline vapor. The review considered the scientific adequacy of the available data and the value of those data for assessing human risk, and suggested additional research that might improve knowledge of human risk from exposure to gasoline vapor.

- For a large pharmaceutical manufacturer, ENVIRON evaluated various methods and techniques for measuring the rate and extent of absorption of nonsystemically absorbed drugs.

- For a large manufacturer, ENVIRON evaluated the carcinogenicity data of glass wool fibers and assessed the appropriateness of using the data to list glass wool fibers as a carcinogen under California's Proposition 65.

- ENVIRON reviewed the chemical structures of components of a lubricant to determine whether they were listed directly or in another form on the TSCA Chemical Substance Inventory.

- For a consortium of major oil companies, ENVIRON searched the USEPA data base of TSCA Section 8(e) report submissions to determine whether any reports had been filed for a particular chemical of concern.

- For a consortium of natural gas producers, ENVIRON evaluated whether a newly discovered contaminant in a product required reporting under TSCA Section 8(e).

- ENVIRON provided assistance to a major insurance company in assessing the risks involved with insuring USTs. The analysis included an overview of the factors contributing to both frequency and severity of releases and how these factors contribute to risk.

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Data Management Plan

DATA MANAGEMENT PLAN

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DELPHI ENERGY & CHASSIS SYSTEMS
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FLINT, MICHIGAN

U.S. EPA ID # MID 005 356 647

by

Haley & Aldrich, Inc.
Cleveland, Ohio

for

Delphi Corporation
Troy, Michigan

File No. 49017-007
March 2003

HALEY & ALDRICH

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HALEY & ALDRICH

I. INTRODUCTION

This Data Management Plan (DMP) is submitted as an attachment to and forms part of the RCRA Facility Investigation (RFI) Work Plan submitted by Delphi Corporation for the Dort Plant 400 Site. The RFI Work Plan was prepared to detail the investigation work necessary to characterize potential releases of hazardous constituents from the Site.

The DMP identifies procedures to be employed for managing information, reports, and correspondence (documents) associated with the RFI at the Site. It is anticipated that this investigation and evaluation program will result in significant amounts of data, including chemical laboratory analytical results for many constituents in different media, at various sampling locations, and at different times. These documents will be readily accessible and the integrity and accuracy of those documents will be maintained. Established data management procedures described herein will be undertaken to effectively process these data.

The DMP consists of two tasks:

- Data Management; and
- Data Control

The data management task consists of procedures used to collect, handle, and safeguard all data generated by field and laboratory programs. The task of document control involves implementing procedures to physically track all documents associated with the RFI.
This plan also provides the format to be used to present the raw data, data reduction, and conclusions of the investigation.

Ban Shamoon, the Haley & Aldrich Project Coordinator, will be responsible for all aspects of this DMP.

A number of items referenced in this plan are more specifically detailed in the Project Management Plan (PMP) and the Quality Assurance Project Plan (QAPP), which have been developed for this RFI and are incorporated herein by reference.

II. PROJECT FILE REQUIREMENTS

Due to the volume of information associated with this project, a central file system will be established in the Haley & Aldrich, Inc. (Haley & Aldrich) Detroit, Michigan office as a repository for all relevant project documentation. The central file will contain project data, records, reports, correspondence and other documentation related to the project. A separate public information repository will be established by Delphi and maintained at the Flint Public Library as detailed in the Community Relations Plan (CRP).

The Haley & Aldrich central file will be divided into subsections by investigative phases/areas. Each investigative phase will be further subdivided into specific tasks and their respective reports, correspondence, subcontracts, field notes, calculations, analytical data, laboratory QA/QC, and others as appropriate.

The file will be the responsibility of Haley & Aldrich and will be audited periodically by the Haley & Aldrich Project Manager to make sure the information is complete and up to date. During field activities, select materials may be copied to a satellite file location and maintained by designated field personnel to ensure immediate availability.

The information contained in the central file will be available for the U.S. EPA (or its authorized representative) to inspect and copy, including sampling, testing and monitoring data generated during the facility investigation field events. It is anticipated that this information (e.g., validated analytical data) will be provided to the U.S. EPA in the various report submittals (e.g., Quarterly Progress Reports, Phase Reports, etc.), or can be provided at the U.S. EPA's request.

At the completion of the project, a copy of all file materials will be transferred into Delphi's possession and these files will be maintained for a minimum of six years after the conclusion of all activities. U.S. EPA will be notified in writing by Delphi at least 90 days prior to the disposal of any such materials so that they may be provided the opportunity to take possession. This written notification will be addressed to:

Patricia J. Polston
Waste, Pesticides and Toxics Division
United States Environmental Protection Agency
77 West Jackson Boulevard, DW-8J
Chicago, IL 60604-3590

The contract laboratory selected for the RFI will be required to retain files containing the original documents generated for all validated test results, in the form of certified analytical reports (CARs). At such time that it is no longer practical for the contracted laboratory to retain this material, it will be forwarded to the Haley & Aldrich Detroit, Michigan office to be included in the central project file.

Similarly, any file material generated by other contract or subcontract parties will be maintained until such time that it is no longer practical, and will then be forwarded to the Haley & Aldrich Detroit, Michigan office to be included in the central project file.

III. DATA MANAGEMENT

Data management includes procedures relating to the collection, recording, retrieval, presentation, documentation, and security of field and laboratory data generated. Data documentation shall include, but may not be limited to, the following:

- field data,
- photographs and videos,
- laboratory analytical data; and
- quality assurance/quality control data.

These data and data security procedures are discussed in the following sections.

3.1 Data Collection

The purpose of sampling is to produce information to be used during data analysis and interpretation. Data interpretation relies upon knowledge of the relationships between samples, including field and analytical duplicates, different analytical methods, and different measurement bases. To ensure effective use of the data within the database, these relationships must be explicitly encoded in sample identifiers and notations. Samples that are inappropriately identified in the field can prevent and obscure data interpretation.

Sample characteristics and analytical information must also be recorded by field personnel on the appropriate field forms (described in the FSP). The sample characteristics of concern are dictated by the data analyses that are required. A complete record of these characteristics is necessary to allow data to be properly selected or sorted later. Analytical information for each sample will be recorded at the time of collection so that sample analysis requests can be properly prepared and laboratory performance and data completeness can be assessed.

3.1.1 Field Data

Data generated in the field will be recorded on standard field forms. The field forms are the primary means of recording field-related information. Examples of field forms may include: soil boring log; well completion report; groundwater sampling record; daily field report; and chain-of-custody documentation. The field forms will contain data including, but not limited to, the following:

- general field observations;
- field measurements and observations;
- sample location and corresponding sample number;
- relevant comments and details pertaining to the samples collected;
- documentation of activities and procedures;
- weather conditions;
- a listing of all personnel involved in Site-related activities;
- an accurate log of all telephone conversations and Site meetings; and

- field decisions made and pertinent information associated with the decisions.

The field forms will be completed in accordance with the FSP and reviewed and maintained in accordance with the QAPP.

3.1.2 Photography and Video

Historic still photographs and videos provide a means of visually recording facility conditions and operations. To ensure accurate storage and retrieval, all photographs and videos taken during the RFI will be documented, cataloged and stored.

Documentation of all photography and video will consist of, but will not be limited to, the following:

- identification of the facility, project and designated project number;
- identification of the area and/or activities photographed;
- orientation and direction of photograph;
- date and time of photograph;
- weather conditions; and
- a unique number identifying the photograph.

Photographs and videos pertaining to the RFI will be stored within Haley & Aldrich's central file. If a digital camera is used, photographs will form part of the electronic database for the project.

3.1.3 Laboratory Analytical Data

Laboratory analytical data, as well as field analytical data, will be compiled in a project-specific relational database. Data will be submitted in an electronic copy as well as original laboratory report. The electronic data will be reported in the Electronic Data Deliverable (EDD) Standard as detailed in "Electronic Data Deliverable" (U.S. EPA, August 2000) (Appendix A) for direct input into the Microsoft Access format. Original laboratory reports will be maintained in the Haley & Aldrich central file. The database will be backed up on a regular basis.

3.2 Data Validation

All data generated through field activities or by the laboratory operation will be reduced and validated prior to reporting. Field and laboratory data will be subjected to the procedures summarized in subsections presented below:

3.2.1 Data Reduction

3.2.1.1 Field Data Reduction Procedures

The measurement of hydrogen ion concentration (pH), specific conductivity, temperature, turbidity, and volatile organic compound (VOC) levels will be collected in the field using direct reading instruments following calibration per manufacturer's recommendations as outlined in Section VI of this DMP. Since direct reading instrumentation will be employed, data reduction procedures will be limited in scope as compared to the procedures used in the data reduction of laboratory analyses. Field measurement data will be written into field forms immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed and dated by the field technician, and corrected in a space adjacent to the original (erroneous) entry. After the completion of field activities, the field crew will transcribe the data onto project specific report forms. The Project Coordinator, identified in Section II of this DMP, will review the forms to confirm that transcription errors have not been made by the field crew.

3.2.1.2 Laboratory Data Reduction Procedures

For this project, the equations that will be employed in reducing data are those in the appropriate chapter and methods of SW-846, Third Edition. Two of these equations, expressing analytical accuracy and precision, are presented in Section III of the QAPP. Such formulae make pertinent allowances for matrix type. All calculations are checked at the conclusion of each operating day. Errors are noted, corrections are made, with the original notations crossed out legibly as described above. Analytical results for soil samples shall be calculated and reported on a dry weight basis.

Quality control data (e.g., laboratory duplicates, surrogates, matrix spikes, and matrix spike duplicates) will be compared to the method acceptance criteria. Data summaries will be sent to the Laboratory QA Manager for review. If approved, data will be entered into the project database electronic deliverable format. Case narratives will be prepared which will include information concerning data that fell outside acceptance limits and any other anomalous conditions encountered during sample analysis. Unacceptable data shall be appropriately qualified in the project printed report and electronic data deliverable (EDD).

3.2.2 Data Validation

Data validation procedures shall be performed for both field and laboratory operations as described below:

3.2.2.1 Procedures Used to Evaluate Field Data

Procedures to evaluate field data for this project primarily include checking for transcription errors and review of field forms. This task will be the responsibility of the Project Coordinator.

3.2.2.2 Procedures to Validate Laboratory Data

The data to be provided incorporates a rigorous level of quality control. All methods will strictly follow EPA approved protocols and quality control criteria. The QA Officer will review and validate data using the following documents as guidance for the review process:

"U.S.EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review", EPA-540/R-99/008, October 1999 and the "U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review ", EPA-540/R-94-013, February 1994.

Validation will be performed, by qualified chemists at the direction of the Project QA Officer. Data review and validation will consist of two tiers of assessment that incorporates an approach similar to procedures prescribed by:

"U.S.EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review", EPA-540/R-99/008, October 1999 and the "U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review", EPA-540/R-01-008, July 2002.

"Innovative Approaches to Data Validation", U.S.EPA Region III, June 1995.

Tier I data validation will be performed on 100% of the laboratory quality control summary data deliverables.

Organic Analysis

i) technical holding times;.

ii) GC/MS instrument performance check;

iii) initial and continuing calibration;

iv) internal standard performance

v) method, trip and field blanks;

vi) system monitoring compounds (surrogate spikes);

vii) MS/MSD results;

viii) laboratory control samples; and

ix) field duplicate samples.

Inorganic Analysis

i) technical holding times;

ii) blanks;

iii) laboratory control samples;

iv) MS/MSD results; and

v) field duplicate.

Tier II validation will be completed on 10 percent of the expanded deliverables during the initial investigation activities. The following deliverables will be evaluated during tier II validation:

Organic Analyses

i) technical holding times;

ii) GC/MS instrument performance check;

iii) initial and continuing calibration;

iv) blanks;

v) system monitoring compounds (surrogate spikes);

vi) MS/MSD results;

vii) laboratory control samples;

viii) internal standard performance;

ix) system performance;

x) retention time windows (GC analyses); and

xi) field duplicates

Inorganic Analyses

i) technical holding times;

ii) initial and continuing calibration;

iii) blanks;

iv) interference check samples;

v) laboratory control samples;

vi) matrix duplicate sample analysis;

vii) matrix spike sample analysis;

viii ICP interference check sample;

ix) ICP serial dilution;

x) ICP/MS internal standard performance;

xi) sample result verification; and

xii) field duplicates.

The completeness of each data package will be evaluated by the Data Validator. Completeness checks will be administered on all data to determine whether deliverables specified in the QAPP are present. At a minimum, deliverables will include sample chain-of-custody forms, analytical results, QC summaries and supporting raw data from instrument printouts. The review will determine whether all required items are present and request copies of missing deliverables.

The overall completeness of the data package will be evaluated by the QA Officer. Completeness checks will be administered on data to determine whether deliverables specified in the RFI Work Plan and QAPP are present. Deliverables are described in Section 9.3 of the QAPP. The reviewer will determine whether all required items are present and request copies of missing deliverables.

3.2.3 Data Reporting

Data reporting procedures shall be carried out for field and laboratory operations as indicated below:

3.2.3.1 Field Data Reporting

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of measurements made in the field and documentation of field calibration activities.

3.2.3.2 Laboratory Data Reporting

The laboratory data reporting package is provided in Section 9.3 of the QAPP.

3.3 Data Analysis

All data analysis will be performed using the most current validated data available. To ensure adherence to this rule, all analytical results will be maintained in a single relational database and all data analyses will begin with retrieval of the relevant data from the database. Secondary data storage formats (e.g., spreadsheets, etc.) will be created as needed for each analysis, but not utilized as a data source for other analysis.

3.4 Data Storage and Retrieval

Sample collection, sample analysis, data validation, and data analysis will be carried out to minimize or eliminate errors resulting from lost, ambiguous, or incomplete data. Data management efforts will focus on:

- Collecting and organizing all of the information necessary to identify and characterize sampling locations, samples, and analytical results.
- Establishing a single source (i.e., relational database) to be referenced for any data used for analysis.
- Controlling modifications to data in the database.
- Providing reliable means of selecting, summarizing and presenting data.
- Backing up the relational database on a regular schedule.

The data management approach to be used takes advantage of appropriate general- and special-purpose software tools. These include databases for the storage of environmental data, statistical software and spreadsheets for data analysis, and graphics software for the presentation of analytical results.

All sampling locations, sample description, and analytical results will be stored in a project-specific EQuIS™ format relational database (Microsoft Access 97 compatible). The database provides a single systematic means of storing all of the environmental data collected during the Investigation. Benefits resulting from use of the database include:

- The database acts as a central repository, eliminating problems of data loss, duplication, and conflict that can arise when data are stored in different locations and formats;

- All data of a given type (e.g. groundwater analytical) are represented uniformly, allowing synthesis of data regardless of its origin;

- Electronic data provided by the analytical laboratory can be automatically loaded, eliminating transcription errors; and

- Computerized searching, selecting, and summarizing of data allows the site characteristics and status to be assessed more quickly, reliably, and cheaply than is possible using paper files.

The established database will be network-compatible, allowing multiple users simultaneous access to the data. The database will allow interaction with mapping software, statistical software, graphic software, and models for data analysis. The database will be formatted in accordance with "Electronic Data Deliverable" (U.S. EPA, June 2001) presented in Appendix A.

3.5 Data Presentation

The data collected and/or generated as part of the RFI will be presented in tabular, graphical, and/or electronic formats.

Tables of analytical data will be developed to present the data in a useable format. Analytical data will be manipulated using Haley & Aldrich's database management system, which uses EQuIS™. Other information that will be presented in tabular form includes: groundwater elevations, and results of soil and groundwater sampling.

Graphical data presentation in the form of figures, plans or charts/graphs will also be included in the RFI Report. Information that will be presented in this format includes: sample areas, sampling locations, contaminant distribution, and any other information where a graphical presentation would be appropriate.

3.6 Data Security

Access to data will be restricted by the use by physical locks placed upon paper copies of data. As required by the needs of the project, filing cabinets can be locked or placed in a locked room. In addition, the privilege of access to the central database will also be restricted to designated personnel as is standard in EQuIS™ Databases.

Recovery from accidental damage to data is supported by standard procedures for backup and off-site storage of computerized data. Backups are typically performed daily, but may be made more frequently if necessary.

IV. DOCUMENT CONTROL

Documents used for and generated during the RFI will be stored and maintained in a unique project file by Haley & Aldrich. Delphi will maintain a file of related documents (RFI Work Plan, Current Conditions Report).

The documents covered by document control procedures are as follows:

- **Background Information Files**

Background information files include reports of previous Site sampling programs, copies of Site files from U.S. EPA, and miscellaneous correspondence.

- **Primary Data Documents**

Primary data documents include field forms, analytical reports, chain-of-custody forms, U.S. EPA correspondence, personnel medical records, meeting minutes and telephone conversations, QA/QC data, Site plans, and survey notes.

- **Project Documents**

Project documents may include reports generated during the RFI and forwarded to the U.S. EPA.

V. PROGRESS REPORTS

Beginning with the first full month of field work, Delphi will provide the U.S. EPA with signed quarterly progress reports and will continue to do so throughout the implementation of the RFI. The progress reports contain:

1. Description of the RFI work completed;
2. Summary of all changes made in the RFI;
3. Summary of contacts with local or state representatives and interest groups;
4. Anticipated or potential problems;
5. Actions taken to rectify problems;
6. Changes in personnel; and
8. Projected work for the next reporting period.

It should be noted that only fully validated laboratory data will be available for submission with the quarterly progress reports.

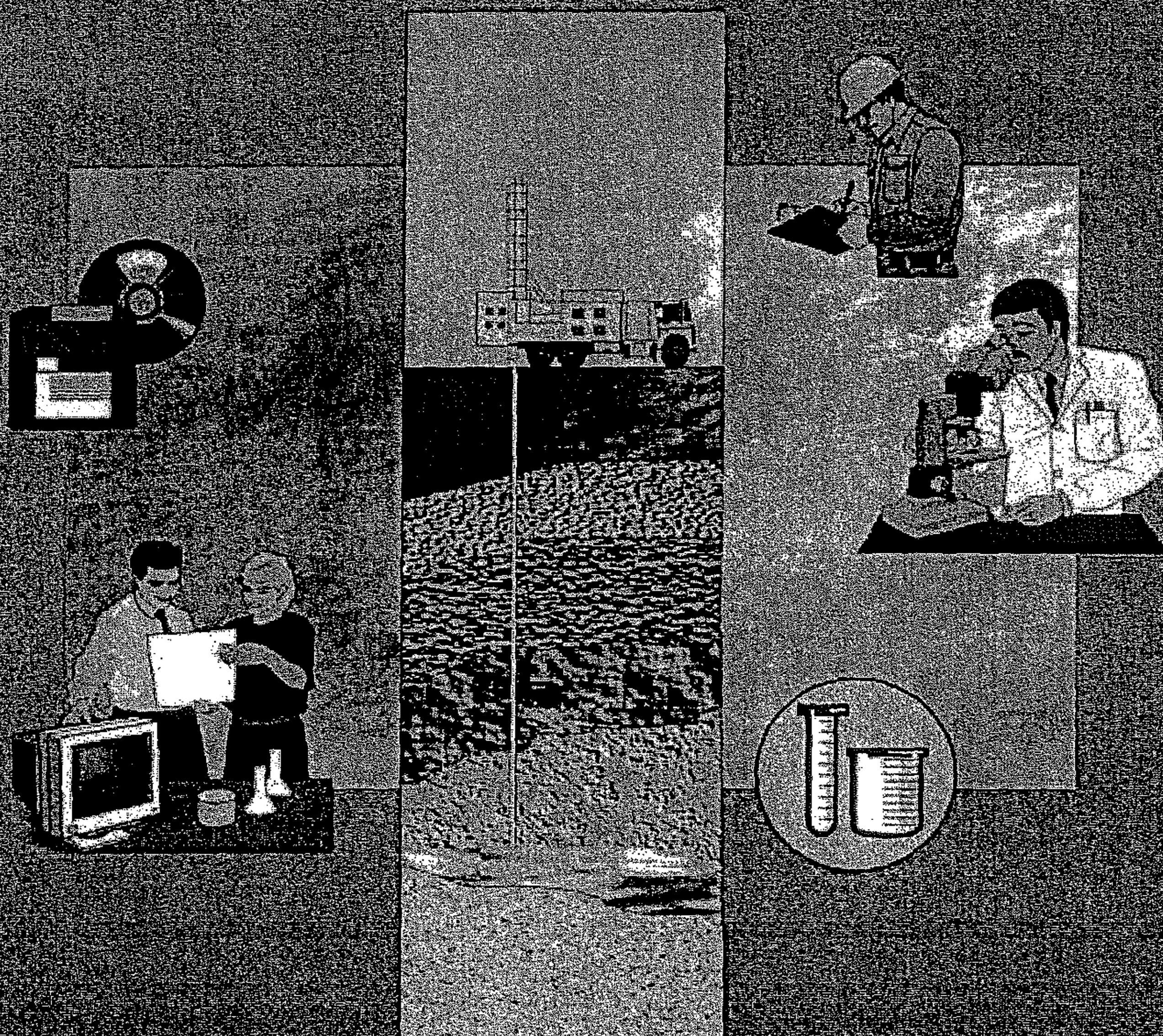
Appendix A

Electronic Data Deliverable (EDD)

Electronic Data Deliverable (EDD)

Specification Manual

Version 1.05



U.S. Environmental Protection Agency
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June 2001

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EarthSoft Inc. prepared the Electronic Lab Data Checker (ELDC) and the Electronic Field Data Checker (EFDC) programs and reviewed the EDD document to assure its technical accuracy.

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7. APPENDIX VALID VALUES

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EXECUTIVE SUMMARY

The purpose of this document is to provide detailed instructions for the reporting of environmental data generated by site characterization and investigation, installation of monitoring wells, and continued sampling at a site. It describes the Electronic Data Deliverable (EDD) - a combination of requirements and procedures for reporting data in electronic files after each phase of environmental investigation and throughout the site remediation and monitoring process. In this section, a summary is provided to allow managers to understand and guide the process. EPA's goal in defining an EDD is to expedite the transfer of data from the US EPA data providers. Other programs employing this approach have realized significant time and cost savings. The reason this approach is efficient is that it allows the US EPA data providers to fully understand EPA requirements and to communicate these requirements to its employees and contractors. All data can be compiled into the EDD throughout the Monitoring Program and therefore not add a separate data management task once all data have been collected.

The EDD is comprised of three distinct sets of files: Initial, Chemistry, and Geology. The Initial EDD consists of a CAD site drawing and two files containing data pertaining to the site and the sampling locations within a site. Most of the data submitted over the life of the project will be chemistry data. The Chemistry EDD files contain, field measurement, sample, test/result, and water level information. The Geology EDD files contain data regarding drilling activities, lithology, geologic sampling, well construction, down hole point data, and groundwater levels. Figures E-1 and E-2 show the EDD creation process for chemistry and geology respectively.

As shown in Figures E-1 and E-2, the process of creating the EDD files begins with software selection. Many software tools are capable of creating the EDD files including text editors, word processors, spreadsheets, and databases. However, spreadsheets and databases are designed to enter and manage data and are really the best tools to use. Microsoft® Access and Excel users can use the files contained on EPA Region 5's ED MAN website located at http://www.epa.gov/region5superfund/edman, that are already formatted and ready for data entry. Users of other software can convert the Excel or Access files or can define the EDD in the software of their choice. The production of the data tables will normally be a collaborative effort between laboratories and environmental contractors. The laboratories will typically produce the test/results tables while the contractors normally will produce all of the other tables.

After the software has been selected the data entry process begins. As shown in Figures E-1 and E-2, there are several decision points that exist to prevent redundant chemistry data reporting. For example, the data describing a site and the site contact should only be reported once. When creating the EDD ask, "Has the site ever been reported?" If the answer is yes, then no site file should be reported with the EDD. If the answer is no, then this must be the first EDD reported for that site and therefore the site file should be reported. A similar decision process is followed for locations. Locations only need to be reported once for any site. The only time a location is reported more than once is if the data have changed in some way. For example, the location may have been resurveyed. Sample, test, and results data constitute the bulk of EDD submissions. While it is rare, it is possible that tests and results are being reported for a sample(s) that was part of an earlier EDD sample file. In this case, the sample data should not be reported again. The Test/Results file should contain new data only. If data are being resubmitted, this must be clearly documented in a cover letter to assure that outdated information is removed from the database. The final step before submitting the EDD files is to check them using the "Electronic Laboratory Data Checker" (ELDC) and the "Electronic Field Data Checker" (EFDC) software that is provided on the EDMAN website. This software will uncover errors in the EDD files that must be corrected prior to submission.

EPA Region 5 is providing a technical help line to assist the US EPA data providers in understanding and using the EDD. Both phone and email support are available. Please see Section 6 of this document for technical support information. Additionally, a US EPA Region 5 ED MAN website has been created. The address is http:/www.epa.gov/region5superfund/edman. A copy of the EDD, valid values, ELDC, and EFDC will be available for download.

Figure E-1. Process flow diagram for the creation and checking of chemistry EDD files

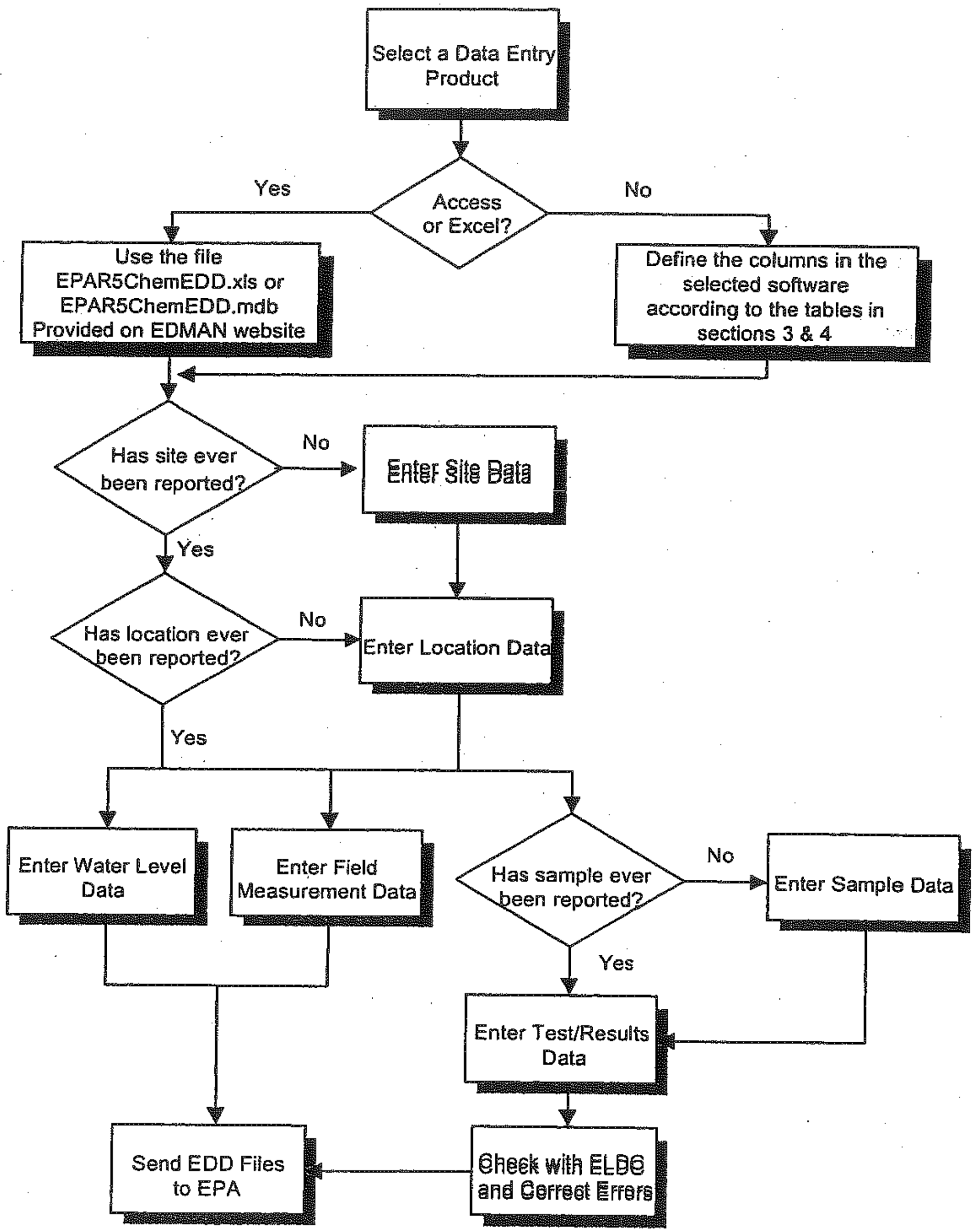
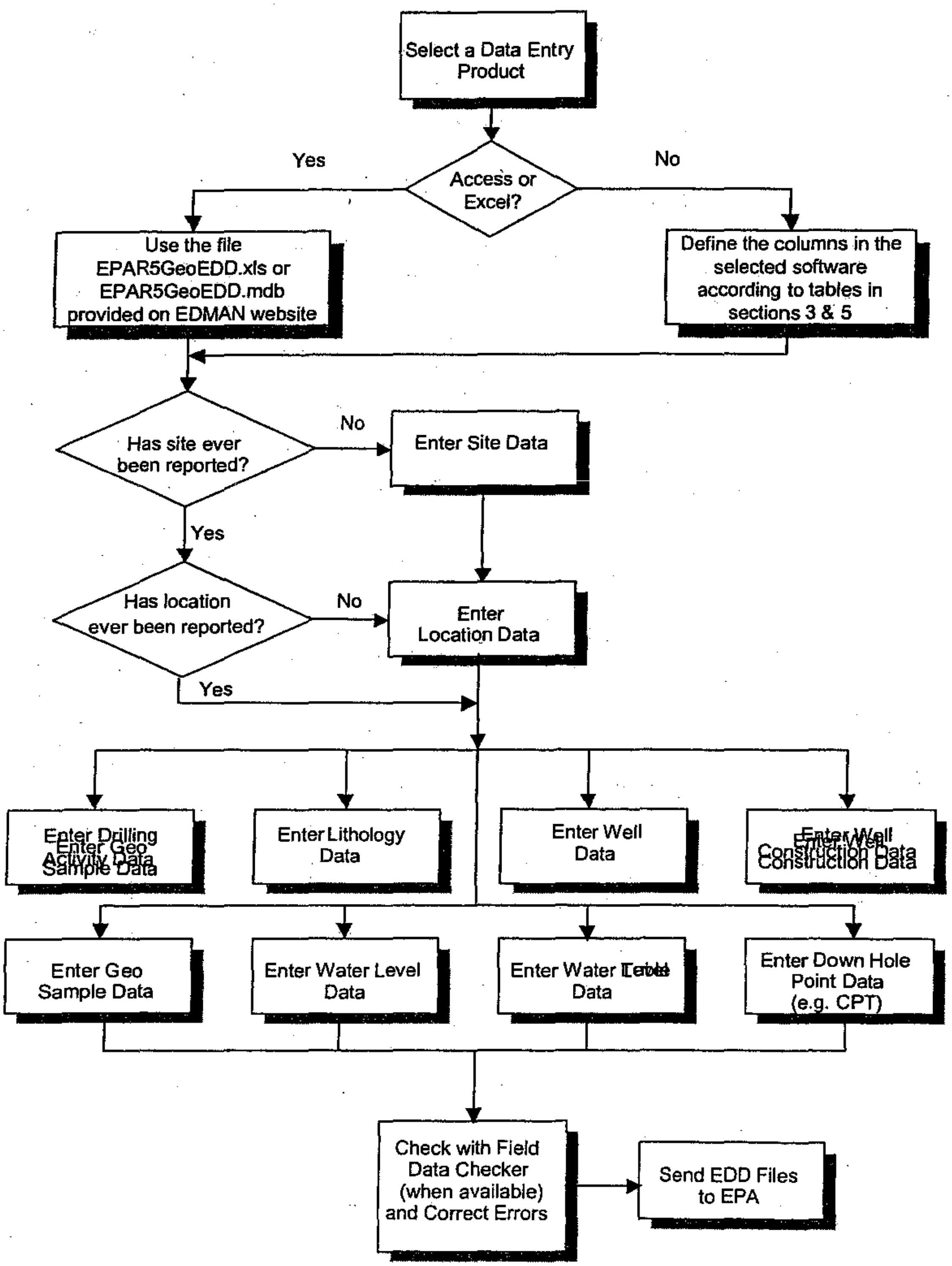


Figure E-2. Process flow diagram for the creation and checking of geology EDD files



1. INTRODUCTION TO THE ELECTRONIC DATA DELIVERABLE (EDD)

EPA Region 5 has developed the Environmental Data Management and Analysis Network (ED MAN) system to improve how environmental data from Superfund sites are acquired and managed. The ED MAN system provides multiple solutions for visually displaying site characteristics, measuring remediation progress, and confirming compliance status. The results of ED MAN will be to accelerate the review of environmental data submissions, improve service to the regulated community, and enhance the protection of the environment and the public. A vital element to the successful deployment of the ED MAN system is the electronic transfer of environmental data from the data providers to EPA in a standardized format. This EDD was developed to facilitate that transfer of data from data providers to the EPA.

The EDD is based on standard EQuIS® EDDs from EarthSoft Inc. The format is designed to be software-independent and easy to achieve. Any spreadsheet, database, or text editor can be used to create the EDD files. Examples of these applications include Access, FoxPro®, Excel, Quattro®, Lotus® 1-2-3®, and Notepad.

Basically, the EDD is a series of file structures that is used to report data. For example, one file structure is used to report location data while another is used to report samples collected at a location. Multiple files are used to eliminate the need to report redundant data. For example, the data (coordinates, elevation, etc.) for a location are reported once in the location file. Many years of data may be reported for that location without reporting the location information again.

This document includes examples that illustrate how the EDD files should look after loading your data into them. In addition, several templates have been provided on the ED MAN website: http://www.epa.gov/region5superfund/edman for loading data into the EDD format and 2 software programs, Electronic Lab Data Checker (ELDC) and Electronic Field Data Checker (EFDC), are provided to check your EDD files before reporting.

The EDD is discussed in five separate sections:

- General reporting requirements are discussed in Section 2.
- The initial site and location file structures are defined in Section 3. These files must be submitted prior to, or in conjunction with, the first Chemistry or Geology EDD submittals.
- The Chemistry file structures are defined in Section 4. Chemistry data accounts for the majority of reportable data for this program.
- The Geology file structures are defined in Section 5.
- Finally, the appendix contains information on valid values and provides a listing of facility IDs for Superfund sites within EPA Region 5.

Each file must be reported exactly as defined in these sections. Any deviations will result in loading errors.

US EPA expects all fields with either "Required" or "If available" to be completed. The data type "Required" only refers to the need of the data in order to load data into the database. There may be data types of "If available" or "If applicable" where the data are not available or applicable. In these cases, include in the cover letter to the Region 5 RPM a description of any fields that are not available or not applicable and the reason why. The data types of "Not wanted" should not be reported. These data types were only included so that other EPA regions or states could use the same EDD but have slightly different data type requirements.

2. REPORTING REQUIREMENTS FOR EDD

2.1 File Formats

With the exception of the electronic base map, all data from the US EPA data providers must be reported as text files using the following standard formats. Each data field must be separated by tabs (tab delimited) or comma delimited (CSV) optionally enclosed in double quotes ("). Data fields containing no information may be represented by two tabs (see example below on Null Format, Section 2.7) or two commas. Maximum length of text fields is indicated in parentheses within the EDD tables shown in Sections 3, 4, and 5. If the information is less than the maximum length, do not pad the record with spaces. Each record (line of information) must be terminated with a carriage return/line feed (created by pressing the enter key in a text editor). Guidance on creating these text files can be found in Section 2.14.

Chemistry and geology data are submitted from the US EPA Data providers in a series of files. Multiple files are used to eliminate the need to report redundant data. Details of the formats for the initial, chemistry, and geology files are presented in Sections 3, 4, and 5, respectively. Table 2-1, Table 2-2, and Table 2-3 provide an introduction to the files that comprise the Initial EDD, Chemical EDD, and Geology EDD, respectively.

An electronic base map must also be submitted along with the initial site and location files. The site base map must be a CAD file in DXF interchange format. Further details regarding the base map are given in Section 3.

Table 2-1. General information on the files that comprise the Initial EDD

File Type	File Name	Created By	Contents	What makes a row of data unique?	Dependence of other files on these data
Base Map	SiteName.DXF	US EPA data provider	Base Map of Site	Not Applicable	Not Applicable.
Site	SiteNameDate. EPAID. EPAR5SITE_v1. txt (or csv)	US EPA data provider	One time definition of site including US EPA data providers data contact information.	site_code	The location file cannot be loaded without properly referenced sites (site_code).
Location	SiteNameDate. EPAID. EPAR5LOC_v1. txt (or csv)	US EPA data provider's surveyor	One entry for each location on a study site. Contains elevation, coordinate and general data. Data should only be reported once for a location.	sys_loc_code	Samples, water levels, and field measurements can only be reported for locations that are defined in this file.

Table 2-2. General information on the files that comprise the Chemistry EDD

File Type	File Name	Created By	Contents	What makes a row of data unique?	Dependence of other files on these data
Chemistry Field Measurement	SiteNameDate. EPAID. EPAR5CFM_v1. txt (or csv)	US EPA data provider's field sampling team(s).	Measurements taken in field and not associated with a sample (e.g. air temperature).	table_name sys_code param_code measurement_date	None.
Chemistry Sample	SiteNameDate. EPAID. EPAR5SMP_v1. txt (or csv)	US EPA data provider's field sampling team(s).	One row for each sample collected at the study site.	sys_sample_code	Tests/results and batch data can only be reported for samples that are defined in this file.
Chemistry Test/ Result	SiteNameDate. EPAID. EPAR5TRS_v1. txt (or csv)	US EPA data provider's testing lab(s)	One row for each analyte reported for a given sample and test. Additional rows can be added to report total and dissolved results and to report results for re-extracts.	sys_sample_code lab_anl_method_name total_or_dissolved test_type cas_rn analysis_date analysis_time	None.
Chemistry Test/ Result with QC Data (use only if QC data are submitted)	SiteNameDate. EPAID. EPAR5TRSQC_v1. txt (or csv)	EPA contractor lab(s)	Test/Result file with additional fields for QC data.	sys_sample_code lab_anl_method_name total_or_dissolved test_type cas_rn analysis_date analysis_time	None

Table 2-2. General information on the files that comprise the Chemistry EDD (continued)

File Type	File Name	Created By	Contents	What makes a row of data unique?	Dependence of other files on these data
Batch (use only if QC data are required)	SiteNameDate. EPAID. EPAR5BAT_v1. txt (or csv)	EPA contractor lab(s)	Data that relates laboratory quality control samples with field samples that were processed and analyzed together.	sys_sample_code lab_anl_method_name test_batch_id	None.
Water Level	SiteNameDate. EPAID. EPAR5GWTR_v1. txt (or csv)	US EPA data provider's field sampling team(s)	Groundwater level data for monitoring wells	sys_loc_code sys_well_code measurement_date measurement_time sequence	None.

Table 2-3. General information on the files that comprise the Geology EDD

File Type	File Name	Created By	Contents	What makes a row of data unique?	Dependence of other files on these data
Drilling Activity	SiteNameDate. EPAID. EPAR5DRA_v1. txt (or csv)	US EPA data provider's Geologist	General Information regarding soil borings	sys_loc_code event	None.
Lithology	SiteNameDate. EPAID. EPAR5LTH_v1. txt (or csv)	US EPA data provider's Geologist	Lithology data for a borehole.	sys_loc_code start_depth	None.
Well	SiteNameDate. EPAID. EPAR5WEL_v1. txt (or csv)	US EPA data provider's Geologist	general information regarding wells	sys_loc_code sys_well_code	Well Construction and Water Level data can only be reported for wells that are defined in this file.

Table 2-3. General information on the files that comprise the Geology EDD (continued)

File Type	File Name	Created By	Contents	What makes a row of data unique?	Dependence of other files on these data
Well Construction	SiteNameDate. EPAID. EPAR5WSG_v1. txt (or csv)	US EPA data provider's Geologist	Well construction details recorded during well construction.	sys_loc_code sys_well_code segment_type start_depth material_type_code	None.
Geology Samples	SiteNameDate. EPAID. EPAR5GSMP_v1. txt (or csv)	US EPA data provider's Geologist	Results for geological, physical properties of samples.	geo_sample_code	None.
Water Level	SiteNameDate. EPAID. EPAR5GWTR_v1. txt (or csv)	US EPA data provider's field sampling team(s)	Groundwater level data for monitoring wells	sys_loc_code sys_well_code measurement_date measurement_time sequence	None.
Water Table	SiteNameDate. EPAID. EPAR5TBL_v1. txt (or csv)	US EPA data provider's Geologist	General Information pertaining to water table	sys_loc_code type	None.
Down Hole Point (CPT) Data	SiteNameDate. EPAID. EPAR5DHP_v1. txt (or csv)	US EPA data provider's Geologist	Results of all down hole logging such as CPT, resistivity, or other geophysical logs.	sys_loc_code depth param	None.

2.2 Initial Data Submittals

The initial data submittal consists of a site base map and two data files: Site File and Location File. Initial submittals provide information pertaining to the monitoring site and sampling locations within the site. The base map, Site file, and Location file need only be submitted once at the beginning of the project and resubmitted only when changes occur. Examples of changes that would require resubmittal include a change in the site contact or locations being resurveyed. New sampling locations established after the initial Location file submittal requires a new submittal with data only pertaining to the new locations. Instructions for submitting your EDDs to EPA are presented in Section 2.16 Submitting Your EDD to EPA.

2.3 Chemistry Data Submittals

There are two (2) types of Chemistry data submittals: Recurring and Correction.

- Recurring submittals are submitted on a cyclic basis and should include the files: Field Measurement, Chemistry Sample, Test/Results, Batch (if required), and Water Level. Data should not be reported for laboratory generated quality control samples but should be reported for field duplicates, field blank, field spike, and trip blanks.

- Correction Reports are those files submitted to correct previously submitted reports. Laboratory retests should be reported as discussed in Section 2.10.

Instructions for submitting your EDDs to EPA are presented in Section 2.16 Submitting Your EDD to EPA.

2.4 Geology Data Submittals

Sites reporting data from monitoring wells installed more than one year prior to the date of data submittal are not required to submit any of the Geology tables. However, for all newly installed monitoring wells (i.e., wells installed within one year from the date of data submittal), and monitoring wells installed in the future, data providers must submit all applicable Geology files as detailed in Section 5. All applicable Geology files must also be submitted for data collected via direct push sampling (e.g., cone penetrometer).

There are two (2) types of Geology data submittals: Original and Correction.

- Original submittals consist of Geology data obtained during subsurface investigations at the site. The original Geology submittal should consist of all Geology files if the data are available. Unlike the Chemistry EDD submittals which are submitted on a cyclic basis, in most cases the Geology EDD is submitted only once. An additional Geology EDD is submitted only if new geology data is obtained after the original EDD was submitted to the EPA.
- Correction submittals are those files submitted to correct errors from previously submitted EDDs.

Instructions on submitting your EDDs to EPA are presented in Section 2.16 Submitting Your EDD to EPA.

2.5 File Naming Convention

Each file, except the base map file, must be named according to the following convention:

SiteNameDate.EPAIDCode.EDD File Format.txt (or .csv)

For example, the fourth quarter ground water sampling for 1999 at the ABC site, EPA Site XYZ123456789 would be reported in a file named ABC20000219.XYZ123456789.EPAR5SMP_v1.txt (or .csv). The first part of the file name is the site name and submission date in YYYYMMDD format. The second part of the file name is the 12 character alphanumeric EPA ID for the facility under investigation. EPA IDs for EPA Region 5 sites are provided in Appendix A.1. The third part of the file name refers to the EDD file format for the file being submitted. In the above example, the Chemistry sample file is being submitted, therefore the EDD File format is EPAR5SMP_v1. The last part is an extension that will be either "txt" if the file was saved as tab delimited or "csv" if saved as comma delimited. Table 2-4 describes the naming formats and submission type for the Initial, Chemistry and Geology files.

Table 2-4. EDD file name formats

File Type	File Contents	EDD File Name	Submission Type
Initial	Base Map	Sitename.DXF	Initial
Initial	Site	SiteNameDate.EPAIDCode.EPAR5SITE_v1.txt	Initial
Initial	Location	SiteNameDate.EPAIDCode.EPAR5LOC_v1.txt	Initial
Chemistry	Field Measurements	SiteNameDate.EPAIDCode.EPAR5CFM_v1.txt	Recurring
Chemistry	Sample	SiteNameDate.EPAIDCode.EPAR5SMP_v1.txt	Recurring
Chemistry	Test/Results	SiteNameDate.EPAIDCode.EPAR5TRS_v1.txt	Recurring
Chemistry	Test/Results QC	SiteNameDate.EPAIDCode.EPAR5TRSQC_v1.txt	Recurring
Chemistry	Batch	SiteNameDate.EPAIDCode.EPAR5BAT_v1.txt	Recurring
Chemistry	Water Level	SiteNameDate.EPAIDCode.EPAR5GWTR_v1.txt	Recurring
Geology	Drill Activity	SiteNameDate.EPAIDCode.EPAR5DRA_v1.txt	Original
Geology	Lithology	SiteNameDate.EPAIDCode.EPAR5LTH_v1.txt	Original
Geology	Well	SiteNameDate.EPAIDCode.EPAR5WEL_v1.txt	Original
Geology	Well Construction	SiteNameDate.EPAIDCode.EPAR5WSG_v1.txt	Original
Geology	Geology Samples	SiteNameDate.EPAIDCode.EPAR5GSMP_v1.txt	Original
Geology	Water Level	SiteNameDate.EPAIDCode.EPAR5GWTR_v1.txt	Original
Geology	Water Table	SiteNameDate.EPAIDCode.EPAR5TBL_v1.txt	Original
Geology	Down Hole Point (CPT) Data	SiteNameDate.EPAIDCode.EPAR5DHP_v1.txt	Original

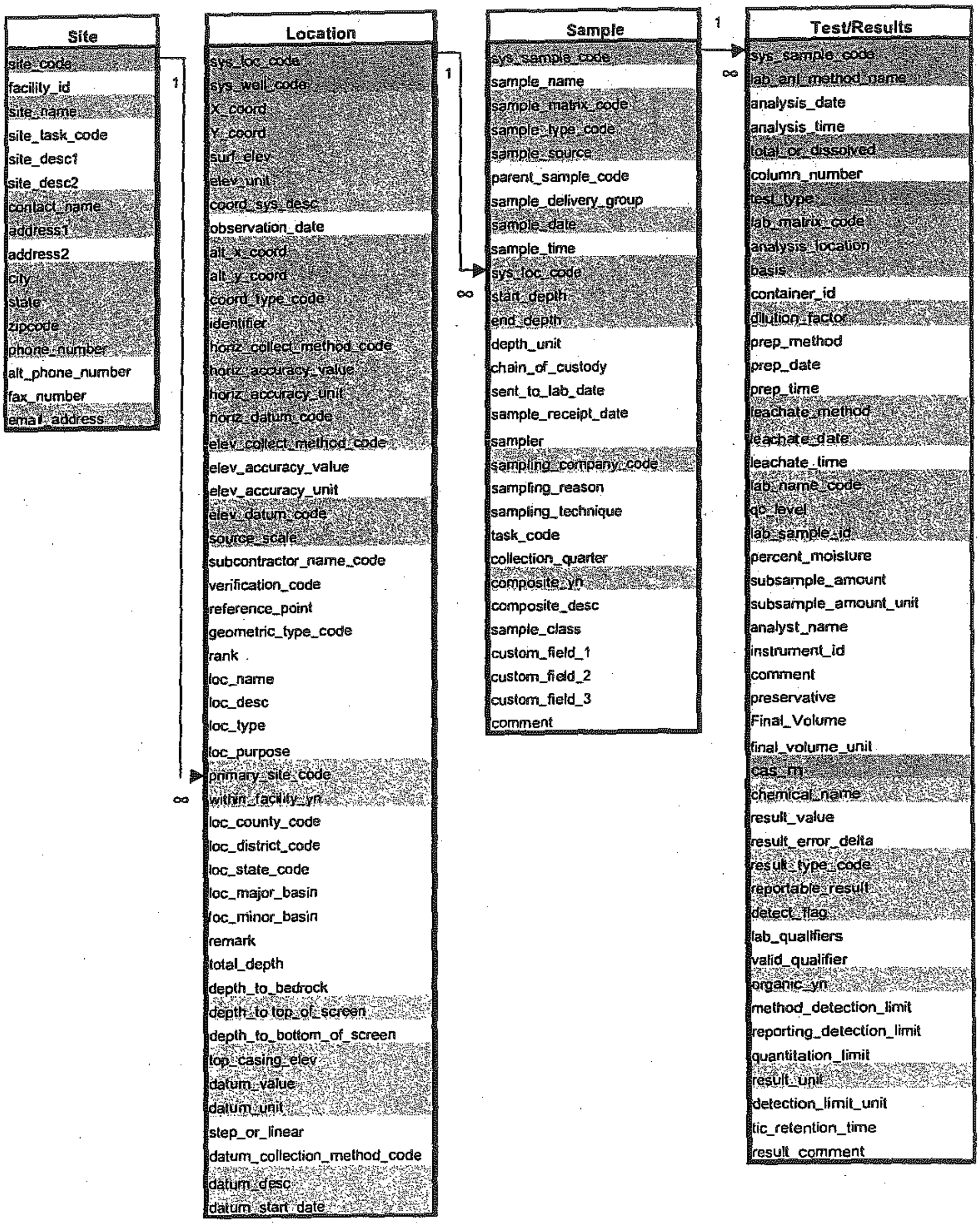
2.6 Data Integrity Rules

Data submitters are responsible for running three types of integrity checks on their data.

- **Validity:** All codes used in a data set must be valid. Valid values for all coded fields are either provided in the description columns of the tables in Sections 3, 4, and 5 or, for more extensive lists, provided in the appendix. For example, the sample matrix is sample_matrix_code field of the sample file and must be reported using one of the values provided in Appendix A.13.
- **Row Uniqueness** must be verified using the guidance provided in Tables 2-1, 2-2, and 2-3. Row uniqueness is assured when no two rows in a file contain the same values for the columns listed under the heading "What makes a row of data unique?" In database terminology this is called a primary key. For example, no two rows in the sample file can contain the same sys_sample_code (commonly called a sample identifier). In addition, no two rows ever reported for a single site can contain the same sys_sample_code. The sys_sample_code must be unique for a site. This is also true of the sys_loc_code (code used to identify a location e.g. MW01) in the Location table. As previously mentioned, it is anticipated that the location(s) will be reported early in the program and that information about each location including water levels and samples collected will be reported throughout the program. In this case, a row for each sys_loc_code should only be reported in the Location file with the first data submission and not with subsequent submissions.

Figure 2-1. Relationships between chemistry file data structures.

Note that the field measurement table is not shown because its relationship depends on the type of measurement taken. Shaded fields are required to have data

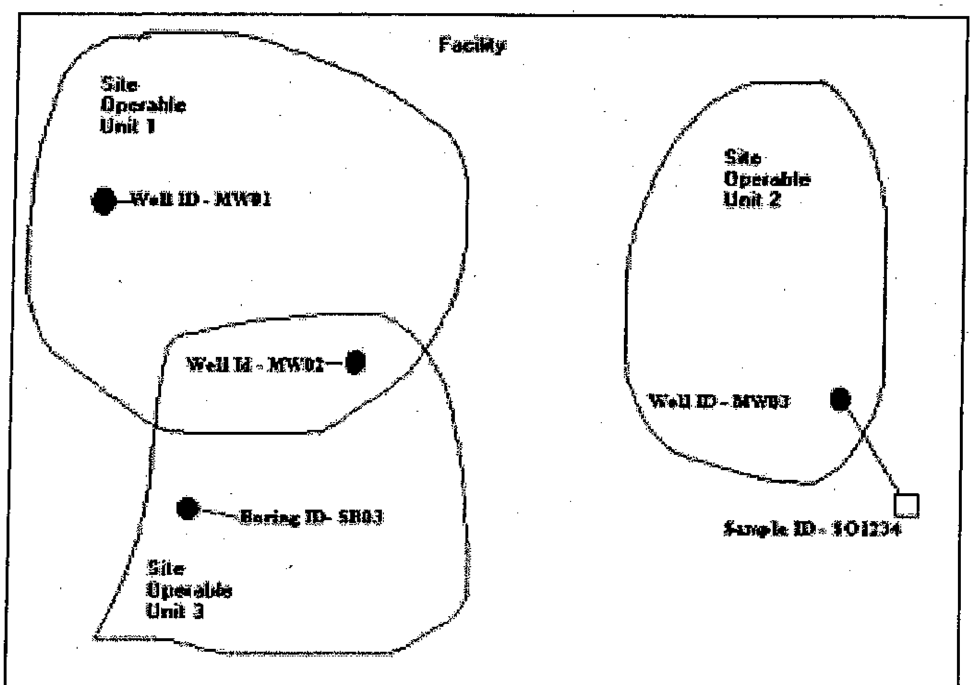


- **Row Integrity:** The relationship between rows within the files of the EDD must be assured by enforcing the "referential integrity" rules discussed in Tables 2-1, 2-2, and 2-3 under the column labeled "Dependence of other files on these data." For example, the values of sys_sample_code present in the Test/Result file must also be present in the Sample file. Logical relationships between the Chemistry files are shown in Figure 2-1 above. The line between files shows which column (or columns) is used to relate the two. The side with the "1" at the end of the line contains one row that is related to many rows on the other side. For example, there is one site row for many location rows because there are many locations at each of the study sites. Logical relationships between the Geology files are limited to the requirement that all sys_loc_codes be reported in the Location table.

2.7 Definition of a Facility, Site, and Location

It is important to understand how this EDD defines a facility, site, and location. Each facility (facility_id) will be identified with its EPA ID number (see Appendix A.1). The site (site_code) will be the operable unit identifier and there is at least one per facility. Each site can contain one or more locations that are distinct points defined by an X and Y Universal Transverse Mercator (UTM) coordinate. Examples of locations include soil borings, monitoring wells, and sampling locations. Each location identifier (sys_loc_code) must be unique for a facility. Figure 2-2 provides a diagram of the facility components.

Figure 2-2. Facility component definitions



Facility Id = EPA ID #
Site = Site Operable Unit = site_name
Must be unique at a Facility

Location= sample location, Well ID, Boring ID = sys_loc_code
Must be unique at a Facility

Data for a location may be reported for more than one Site Operable Unit.

2.8 Reporting Null Values

Many fields are optional in this EDD. When a field is not listed as required in Sections 3, 4, and 5, a null or blank may be appropriate. However, the blank value must still be surrounded by tabs or commas. In other words, the number of fields is always the same, whether or not the fields include data. Refer to Table 2-5 where the second of three fields shown is considered optional.

Table 2-5. Examples of how to report null values

Example	Comment
"data_one"→|"data_two" →|"data_three" "data_one","data_two","data_three"	O.K. All fields populated, one tab or comma between fields.
"data_one" →|→|"data_three" "data_one",,"data_three"	O.K. Optional field not populated, 2 tabs or 2 commas between first and third field.
"data_one" →|"data_three" "data_one","data_three"	Not O.K. Optional field omitted, only 1 tab or comma between first and third field.

2.9 Valid Values

Valid values, also known as reference values or code lists, govern the contents of some fields in the database. In other words, some fields may contain only those values within a certain predetermined range or list of codes. A full list of columns that reference valid values is presented in Table 2-6. This list is also cross-referenced to the file structures presented in Sections 3, 4, and 5. If you require the addition of valid values to any of the tables listed below, contact the data management staff using the contact information provided in the technical support section.

Table 2-6. Cross-reference between the valid value tables in appendix and the EDD files

Valid Value Table	Appendix Sect.	Column	EDD File
Reference point	7.2	Reference_point	Location
Horizontal collection method	7.3	horz_collection_method_code	Location
Horizontal accuracy unit	7.4	horz_accuracy_unit	Location
Horizontal datum	7.5	horz_datum_code	Location
Elevation collection method	7.6	elev_collect_method_code	Location
Elevation datum	7.7	elev_datum_code	Location
Source_code	7.8	source_scale	Location
Loc_type	7.9	loc_type	Location
Analyte	7.10	cas_rn	Test/Results
Lab_anl_method_name	7.11	lab_anl_method_name	Test/ Results
Lab	7.12	lab_name_code	Test/Results
Matrix	7.13	sample_matrix_code, lab_matrix_code	Chemistry Sample, Test/Results
Std_prep_method	7.14	lab_prep_meth	Test/Results
Qualifier	7.15	lab_qualifiers	Test/Results
Result_type	7.16	result_type_code	Test/Results

Table 2-6. Cross-reference between the valid value tables in appendix and the EDD files (continued)

Valid Value Table	Appendix Sect.	Column	EDD File
Sample_type	7.17	sample_type_code	Chemistry Sample
Unit	7.18	depth_unit (Sample), result_unit (Result), subsample_amount_unit (Test)	Chemistry Sample, Test/Result, Well Construction, Geology Samples, Water Level
Geology soil materials	7.19	material	Geology Lithology
Well construction and materials	7.20	segment_type, material	Well Construction

2.10 Reporting Re-tests

For Initial tests, all analytes should be reported. For retests only reportable chemicals should be reported. The initial test will have reportable_result set to "No" for all chemicals that are reported in retests. Table 2.7 provides an example of reporting re-tests.

Table 2-7. Example of reporting re-tests

Test Type	Chem Name	Cas rn	Result Value	Detect Flag	Lab Qualifiers	Reportable Result	Result_Comment
Initial	Benzene	71-43-2	1000	Y	E	No	too concentrated to quantitate
Initial	Toluene	108-88-3	5	N	U	Yes	not detected
Initial	Xylenes	1330-20-7	5	N	U	Yes	not detected
dilution1	Benzene	71-43-2	780	Y		Yes	quantitated

2.11 Reporting Non-detects

Non-detects must be reported as shown in the example below. Each non-detect row must have the detect_flag = N, a reporting_detection_limit, and null in the result value field. Table 2.8 presents an example of reporting non-detects.

Table 2-8. Example of reporting non-detects

Cas rn	Result Value	Detect Flag	Reporting Detection Limit	Detection Limit Unit	Result_comment	Laboratory_ qualifiers
108-88-3	.15	Y	.005	ug/ml		U
108-88-3		N	.005	ug/ml	not detected	U

2.12 Reporting Tentatively Identified Compounds

Tentatively Identified Compounds (TICs) should be reported where available. The naming of TICs should be applied in a cascade fashion. The TIC should be identified to analyte name if possible. If this is not possible, then the TIC should be identified to class. As a final naming choice, the TIC should be identified as Unknown. For the purpose of this EDD, the valid values list assumes the laboratory will report up to 10 TICs. Only the 10 most concentrated TICs should be reported. Table 2-9 shows examples of the nomenclature for TICs. As an example, if a sample has three Unknown Hydrocarbons, then the TICs are labeled UnkHydrocarb1, UnkHydrocarb2, and UnkHydrocarb3. TIC names are to be reported in the cas_rn field, Pos #31, of the Test/Result file (Tables 4-3 and Table 4-4). In addition, the result_type_code, Pos # 35 in the Test/Result file should have "TIC" for all TIC records.

Table 2-9. Example nomenclature for TIC reporting

TIC Name	Number for TIC	Reported Name in cas_rn
Unknown	1-10	Unknown1 – Unknown10
Unknown Hydrocarbon	1-10	UnkHydrocarb1 - UnkHydrocarb10
Unknown PAHs	1-10	UnkPAH1 - UnkPAH10
Unknown Aromatics	1-10	UnkAromatic1 - UnkAromatic10
Unknown VOA	1-10	UnkVOA1 - UnkVOA10
Unknown SV	1-10	UnkSV1 - UnkSV10

2.13 Data Types

The table below describes the data types used in the chemistry and geology file descriptions. In addition to the types listed below, certain fields have single and double data types. The single data type stores number from –3.402823E38 to –1.401298E–45 for negative values and from 1.401298E–45 to 3.402823E38 for positive values, with decimal precision of up to 7. The double data type stores numbers from –1.79769313486231E308 to –4.94065645841247E–324 for negative values and from 1.79769313486231E308 to 4.94065645841247E–324 for positive values, with decimal precision of up to 15.

Table 2-10. Data type descriptions

Type	Description	Decimal Precision	Comments
Integer	Stores numbers from –32,768 to 32,767 (no fractions).	none	
'Y' or 'N'	Boolean field used to indicate yes or no to a question. Enter either Y or N.	NA	
Time	Time in 24-hr (military) HH:MM format.	NA	Text(5) is standard length for time.
Date	Date format is MM/DD/YYYY.	NA	
Text	Stores characters and numbers.	NA	Length restrictions are indicated in parenthesis.

2.14 Data Entry Tools Provided to Create the EDD Files

The files can be produced using any software with the capability to create text files. These files are especially easy to create using spreadsheet or database software packages. However, if these are unavailable, the files can be created using a word processor or text editor. Table 2-11 provides instructions for creating tab delimited text files from some of the more popular software packages. In the near future EPA will publish a field data checker that can be used to validate these text files.

Table 2-11. Instructions for producing tab delimited text files from some popular software packages

Package	Type	Instructions
Access 97	Database	1. Create tables using file structures in Sections 3 and 4 2. After data are entered, close table. 3. Click on table name (under table tab) and then select "File," "Save As" from the top menu. Save to an external file or database. Change "Save as Type" to a text file. Change the file extension from "txt" to "tab." Press OK. This will start the export wizard. 4. In the export wizard, select "Delimited," then press the "Next" button. Select "Tab" as the delimiter type and " as the text qualifier. Press the "Next" button. Select a destination and name for the file. Press the "Finish" button.
Excel 97	Spreadsheet	1. Select "File," "Save As" from the top menu. Change "Save as Type" to a "Text (Tab Delimited)" file. Press the "Save" button.
Quattro® v8	Spreadsheet	1. Select "File," "Save As" from the top menu. Change the "File Type" to "ASCII Text (Tab Delimited)." Press the "Save Button."
Word 97	Word Processor	Warning: A word processor is not the best tool for the job! A large paper size will have to be selected to prevent wrapping for most files. 1. Enter data into a table in Word. Any text entered must be contained within double quotes. 2. Select "Table," "Select Table" from the top menu. When the table is highlighted, select "Table," "Convert to Text," "Separate Text with Tabs." 3. Select "File," "Save As" from the top menu. Change "Save as Type" to "MS DOS Text (*.txt).
Lotus 1-2-3	Spreadsheet	1. Select "File," "Save As" from the top menu. Change "Save as Type" to a "Comma Separated Value (CSV)" file. Provide file name. Press the "Save" button.

Several files are included on EPA's EDMAN website to assist in creating the chemistry and geology EDDs.

- Two Microsoft Excel Workbooks files, EPAR5ChemEDD.xls and EPAR5GeoEDD.xls, provide electronic templates for the EDD files. To create an EDD, simply enter your data into the worksheets provided and then follow the instructions to create a tab delimited text file.
- Two Microsoft Access database files, EPAR5ChemEDD.mdb and EPAR5GeoEDD.mdb also provide electronic templates for the EDD files. To create an EDD, simply enter your data into the database files provided and then follow the instructions to create a tab delimited text file.

2.15 Using the Electronic Data Checkers to Validate EDDs

The Electronic Laboratory Data Checker (ELDC) and Electronic Field Data Checker (EFDC) are used to check the EDD files prior to submittal. The ELDC is used to check the following four Chemistry files: chemistry sample, chemistry test/results, chemistry test/result with QC data, and batch. The EFDC is used to check the remaining EDD files.

The ELDC and EFDC installation files are provided on the EDMAN website as EPAR5_ELDCSetup.EXE and EPAR5_EFDCSetup.EXE. To install ELDC and EFDC, simply double-click on the files and follow the installation instructions. Once ELDC and EFDC are installed on a workstation, they may be used to check the EDD files prior to reporting to EPA. The EDMAN website is http://www.epa.gov/region5superfund/edman.

When the ELDC starts, the user needs to select the EDD file format associated with the type of file that will be checked (i.e., EPAR5SMP_v1 for the chemistry sample file). Table 2-12 shows the correlation between ELDC "EDD file format" and the file types used in the EDD. Next the actual file is selected by using a standard browse function. Finally, the "Check" button is clicked to begin the checking process.

Table 2-12. Correlation between ELDC EDD file formats and chemistry EDD file types

ELDC EDD File Format	Chemistry EDD File Type
EPAR5SMP_v1	Chemistry Sample
EPAR5TRS_v1	Chemistry Test/Result
EPAR5TRSQC_v1	Chemistry Test/Result with QC Data
EPAR5BAT_v1	Batch

When the EFDC starts, the user needs to select the EDD file format associated with the type of file that will be checked (i.e. EPARSITE_v1 for the site file). Table 2-13 shows the correlation between EFDC "EDD file format" and the file types used in the EDD. Next the actual file is selected by using a standard browse function. Finally, the "Check" button is clicked to begin the checking process.

Table 2-13. Correlation between EFDC EDD file formats and EDD file types

EFDC EDD File Format	EDD File Type
EPAR5SITE_v1	Site
EPAR5LOC_v1	Location
EPAR5GWTR_v1	Water Level
EPAR5DRA_v1	Drilling Activity
EPAR5LTH_v1	Lithology
EPAR5WEL_v1	Well
EPAR5WSG_v1	Well Construction
EPAR5GSMP_v1	Geology Samples
EPAR5TBL_v1	Water Table
EPAR5DHP_v1	Down Hole Point Data

If there are errors or warnings an error log is created that can be viewed in detail or summary mode to gain an understanding of the problem. After the errors are corrected, the ELDC and EFDC can be re-run to assure that no errors remain. If error messages remain because new valid value codes are required, the files should be considered clean and reported to EPA with the new codes clearly explained in the cover letter.

2.16 Submitting Your EDD to the EPA

Once the EDD files are complete and ready to submit, the following steps should be taken to assure a streamlined process. Each EDD must be accompanied by a cover letter (please include as electronic text file on diskette as well) that specifies the study site, contact for technical questions, file names, any exceptions to the EDD format, and a clear notification if the EDD contains previously submitted data. If data are being resubmitted, please indicate the reason for resubmission and provide guidance on how to handle the original data (e.g., delete it from the database). Files should not be compressed. Completed EDDs should be sent on a 3.5" IBM-compatible diskette or 100 MB/250MB Zip® Disk that is clearly labeled with the project code and date of transfer to:

Site RPM
US Environmental Protection Agency
77 West Jackson Boulevard
Chicago, Il 60604

In lieu of disk copy, email submissions may be arranged with your RPM.

2.17 Example of a Typical Initial, Chemistry and Geology EDD Deliverable

Examples of Initial, Chemistry and Geology EDD files populated with the first few rows of a typical data set are presented in Figures 2-3, 2-4, 2-5, and 2-6. In order to fit the examples on one page, not all of the fields (i.e., columns) were included for certain files (e.g., Site, Location, Chemistry Sample). *Additional Fields* is denoted where all the fields are not included. It should be noted that all fields are required when submitting EDD files, regardless of whether or not the field is populated (see Section 2.9). The special cases discussed in previous sections are illustrated here together with standard examples.

Figure 2-3. Example Initial EDD ready for conversion to text file

Site File:

site_code	facility_id	site_name	site_task_code	site_desc1	site_desc2	contact_name	address1	*Additional Fields*	email_address
Example	FAC123456723	Example Site				John Smith	23 Main Street		abc@abd.com

Location File:

sys_loc_code	sys_well_code	x-coord	y-coord	surf_elev	elev_unit	coord_sys_desc	observation_date	alt_x_coord	alt_y_coord	coord_type-code	identifier	*Additional Fields*	comment
MW01	MW01	414456.78	4424543.21	120.2	ft	UTM Zone 17	02/21/1999	-82.00231	39.9612	Lat Long	1		
SB-01	NONE	414709.23	4424304.12	126.3	ft	UTM Zone 17	02/23/1999	-82.00531	39.35794	Lat Long	1		
MW03	MW03a	414601.23	4424700.33	130.1	ft	UTM Zone 17	02/22/1999	-82.01023	39.9701	Lat Long	1		
MW03	MW03b	414601.23	4424700.33	130.1	ft	UTM Zone 17	02/22/1999	-82.01023	39.9701	Lat Long	1		

Notes: SB-01 has no well therefore "NONE" is entered in sys_well_code.
MW03a and MW03b are multiple wells within same boring.

Location File of Resurveyed Location

The following table shows the fields requiring data when submitting a new location file resulting from a resurvey of the datum elevation at one location. Only the sys_loc_code, sys_well_code, and the datum elevation fields are populated. All other fields in the location file are left null. In this example, the top of the well casing (TOC) was resurveyed. The elevation was found to be different from the originally reported elevation. The TOC was also used as the datum for the well. Therefore, a new location file needs to be submitted where only the fields shown below are populated with the new data from the resurvey. All other fields need to be null.

sys_loc_code	sys_well_code	*Additional Fields*	top_casing_elev	Datum_value	datum_unit	step_or_linear	datum_collection_method_code	datum_desc	datum_start_date
MW01	MW01		119.2	119.2	Ft	Linear	A1	top of casing	04/12/99

Figure 2-4. Example Chemistry EDD ready for conversion to text file

Chemistry Field Measurements File:

table_name	sys_code	param_code	measurement_date	measurement_time	param_value	param_unit	measurement_method	param_value_background	remark	*Additional Fields*	calibration_date
Site	Example	Temp	07/12/2000	13:30	29	deg c	Thermometer		Ambient air temp		
Location	MW01	pH	07/12/2000	14:20	7.2	Ph units	pH probe		pH of groundwater		

Sample File:

sys_sample_code	sample_name	sample_matrix_code	sample_type_code	sample_source	parent_sample_code	sample_delivery_group	sample_date	sample_time	sys_loc_code	*Additional Fields*	comment
MW01040198		WG	N	Field			04/01/1998		MW01		
MW02040198		WG	N	Field			04/01/1998		MW02		

Test/Result File:

sys_sample_code	lab_anl_method_name	*Additional Fields*	total_or_dissolved	column_number	test_type	lab_matrix_code	analysis_location	basis	*Additional Fields*	dilution_factor	lab_name_code	qc_level	lab_sample_id	*Additional Fields*
MW02040198	SW8240		T		Initial	WG	LB	Wet		1.0	ABC	quant	LAB01	
MW02040198	SW8240		T		Initial	WG	LB	Wet		1.0	ABC	quant	LAB02	
MW02040198	SW8240		T		Reanalysis	WG	LB	Wet		10.0	ABC	quant	LAB02R	

Test/Result file (continued):

cas_rn	chemical_name	result_value	result_error_delta	result_type_code	reportable_result	detect_flag	lab_qualifiers	organic_yn	reporting_detection_limit	quantitation_limit	result_units	*Additional Fields*	result_comment
71-43-2	BENZENE	12		TRG	Yes	Y		Y	10		ug/ml		
108-88-3	TOLUENE			TRG	Yes	N		Y	10		ug/ml		
1330-20-7	XYLENES			TRG	Yes	N		Y	10		ug/ml		

Water Level File:

sys_loc_code	sys_well_code	measurement_date	measurement_time	historical_ref_elev	water_level_depth	water_level_elev	corrected_elev	*Additional Fields*	remark
MW01	MW01	05/10/1999	13:10		31.1	89.1			
MW02	MW02	05/10/1999	13:45		34.1	89.0			

Figure 2-5. Examples of QC data fields within Chemistry EDD

QC fields in a normal field sample (i.e., sample_type_code = N, TB, etc.)
The following table shows some of the fields in the test/result file for a normal field sample. Notice that all QC fields are blank.

cas_rn	result_value	qc_original_conc	qc_spike_added	qc_spike_measured	qc_spike_recovery	qc_dup_original_conc	qc_dup_spike_added	qc_dup_spike_measured	qc_dup_spike_recovery
93-76-5	1.56								
94-75-7	3.17								
94-82-6	2.31								

QC fields in a normal field sample with surrogates (i.e., sample_type_code = N, TB, etc.)
The following table shows some of the fields in the test/result file for a normal field sample. Notice that QC fields are blank except on surrogate rows. Many users will need only the recovery field data; the spike added and spike measured fields will not be needed in most situations.

cas_rn	result_value	result_unit	result_type_code	qc_original_conc	qc_spike_added	qc_spike_measured	qc_spike_recovery
93-76-5	1.56	mg/l	TRG				
94-75-7	3.17	mg/l	TRG				
PHEN2F		mg/l	SUR		12.5	12.9	103

QC fields in a laboratory method blank sample (i.e., sample_type_code = LB)
The following table shows some of the fields in the test/result file for a laboratory method blank sample. Notice that all QC fields are blank.

cas_rn	result_value	lab_qualifier	qc_original_conc	qc_spike_added	qc_spike_measured	qc_spike_recovery	qc_dup_original_conc	qc_dup_spike_added	qc_dup_spike_measured	qc_dup_spike_recovery
93-76-5		U								
94-75-7		U								
94-82-6	0.01									

QC fields in a matrix spike (i.e., sample_type_code = MS)
The following table shows some of the fields in the test/result file for a matrix spike sample. Notice that all "dup" QC fields are blank, and that the result_value field is not needed. Also, the qc_rpd field would be blank for these rows. Many users will need only the calculated recovery field (qc_spike_recovery).

cas_rn	result_value	qc_original_conc	qc_spike_added	qc_spike_measured	qc_spike_recovery	Qc_rpd	qc_dup_original_conc	qc_dup_spike_added	qc_dup_spike_measured	qc_dup_spike_recovery
93-76-5		1.56	4.18	5.36	90.9					
94-75-7		3.17	4.18	7.15	95.2					
94-82-6		2.31	4.22	5.66	79.3					

Figure 2-5. Examples of QC data fields within Chemistry EDD (continued)

QC fields in a matrix spike duplicate (i.e., sample_type_code = SD)

The following table shows some of the fields in the test/result file for a matrix spike duplicate sample. Notice that all "dup" QC fields are completed, and that the result_value field is not needed. Also, the qc_rpd field would be completed for these rows. Many users will need only the calculated recovery field (qc_dup_spike_recovery).

cas_rn	result_ value	qc_ original_ conc	qc_spike_ added	qc_spike_ measured	qc_spike_ recovery	Qc_rpd	qc_dup_ original_ conc	qc_dup_ spike_ added	qc_dup_ spike_ measured	qc_dup_ spike_ recovery
93-76-5						10	1.56	4.23	5.70	97.8
94-75-7						12	3.17	4.23	7.62	105
94-82-6						15	2.31	4.13	5.33	73.1

QC fields in a matrix spike/matrix spike duplicate (i.e., sample_type_code = MSD)

The following table shows some of the fields in the test/result file for a matrix spike/matrix spike duplicate considered as single sample (they can be reported this way, or as two separate samples as shown above). Notice that all QC fields are completed, and that the result_value field is not needed. Also, the qc_rpd field would be completed for these rows. Many users will need only the calculated recovery fields (qc_spike_recovery and qc_dup_spike_recovery).

cas_rn	result_ value	qc_ original_ conc	qc_spike_ added	qc_spike_ measured	qc_spike_ recovery	Qc_rpd	qc_dup_ original_ conc	qc_dup spike_ added	qc_dup spike_ measured	qc_dup spike_ recovery
93-76-5		1.56	4.18	5.36	90.9	7	1.56	4.23	5.70	97.8
94-75-7		3.17	4.18	7.15	95.2	10	3.17	4.23	7.62	105
94-82-6		2.31	4.22	5.66	79.3	8	2.31	4.13	5.33	73.1

QC fields in a LCS (i.e., laboratory control sample, blank spike, sample_type_code = BS)

The following table shows some of the fields in the test/result file for a LCS sample. The qc_rpd field would be blank for these rows. Many users will need only the calculated recovery field (qc_spike_recovery). LCS duplicate samples (i.e., sample_type_code = BD) and LCS/LCSD samples (i.e., sample_type_code = BSD) follow the patterns similar to the SD and MSD samples described above.

cas_rn	result _value	qc_original _conc	qc_spike_ added	qc_spike_ measured	qc_spike_ recovery	qc_dup_ original_ conc	qc_dup_ spike_ added	qc_dup_ spike_ measured	qc_dup_ spike_ recovery
93-76-5			5.00	5.26	105				
94-75-7			1.00	1.02	102				
94-82-6			12.5	12.9	103				

Figure 2-6. Example Geology EDD ready for conversion to text file

Drill Activity File:

sys_loc_code	drill_event	start_depth	end_depth	drill_date	diameter	*Additional Fields*	purpose
W-4A	1a	40	80	07/12/1999	8		Advanced well additional 40 feet to reach lower aquifer
W-6B	2c	45	110	07/14/1999	8		Advanced well 55 feet to reach bedrock.

Lithology File:

sys_loc_code	start_depth	material_type	geo_unit_1	*Additional Fields*	Remark_1	*Additional Fields*	odor
W-1A	0	CL	Glacial		grayish brown clay, trace fine sand, med strength, med plastic, rapid dilatancy ,some brick fragments		
W-1A	10	SW	Outwash		med dense, 50% fine to coarse brown sand, 30% gravel, dry, trace clay		
W-1A	23	SP	Outwash		dense, 70% coarse brown sand, 20% gravel, poorly graded, rounded, moist		
W-2A	0	ML	Alluvial		Dark brown silt with little fine sand, low strength, nonplastic, rapid dilatancy		

Well File:

sys_loc_code	sys_well_code	*Additional Fields*	top_casing_elev	datum_value	datum_unit	datum_desc	*Additional Fields*	geologic_unit_code	remark
W-1A	W-1A		122.0	122.0	ft	top of casing of well		outwash	
W-2A	W-2A		122.3	122.3	ft	top of casing of well		alluvial	

Well Construction File

sys_loc_code	sys_well_code	segment_type	material_type_code	start_depth	end_depth	depth_unit	inside_diameter	*Additional Fields*	remark
W-1A	W-1A	surface plug	concrete	0	1.5	ft	4.5		
W-1A	W-1A	annular backfill	neat cement grout	1.5	8	ft	2.375		
W-1A	W-1A	annular Seal	Bentonite pellets	8	8	ft	2.375		
W-1A	W-1A	Filter Pack	sand pack	8	23.1	ft	2.375		
W-1A	W-1A	Protective Casing	steel	-2.2	3.2	ft	4		
W-1A	W-1A	casing	stainless steel 304	-2.1	24	ft	2		
W-1A	W-1A	screen	stainless steel 304	24	29	ft	2		
W-2A	W-2B	protective casing	steel	-2.0	3.0	ft	2		
W-2A	W-2B	surface plug	concrete	0	1.5	ft	4.5		
W-2A	W-2B	annular backfill	neat cement grout	1.5	10	ft	2.375		

Figure 2-6. Example Geology EDD for new monitoring wells or direct push samples ready for conversion to text file (continued)

Geology Sample File:

sys_loc_code	geo_sample_code	sample_name	sample_top	sample_bottom	sample_date
W-1A	ABCD-1		4	6	04/23/1999
W-1A	ABCD-2		14	16	04/23/1999
W-2A	DEFG-1		5	7	04/24/1999

Additional Fields

sample_method	material_type
split spoon	SW
split spoon	SW
split spoon	SP

Additional Fields

organic_carbon_units

Water Level File:

sys_loc_code	sys_well_code	measurement_date	measurement_time	historical_ref_elev	water_level_depth	water_level_elev	corrected_elev
MW01	MW01	05/10/1999	13:10		31.1	89.1	
MW02	MW02	05/10/1999	13:45		34.1	89.0	

Additional Fields

remark

Water Table File:

sys_loc_code	Type	sequence	depth	flowing_yn	measurement_method	capped_pressure	capped_pressure_unit
MW01	Unconfined	stable	21.2	y	electric sensor		
MW02	Unconfined	stable	21.0	y	electric sensor		

Additional Fields

temperature_unit

Geology Down Hole Point File:

sys_loc_code	depth	param	param_value
MW01	10.8	Tip Stress	612
MW01	11.2	Tip Stress	624
MW01	10.8	Sleeve Stress	6.1
MW01	11.2	Sleeve stress	5.8
MW02	9.5	Resistivity	510
MW02	10.1	Resistivity	521
MW02	11.0	Resistivity	489

3. FORMATS FOR INITIAL FILES

This section contains information regarding the base map and the two tables that define the file structures for the initial EDD. These files are initial files that need to be submitted to EPA prior to, or in conjunction with, the first Chemistry EDD or Geology EDD submission. These files need only be submitted once. The only time a site or location file would be submitted more than once is if the data had changed in some way (e.g., contact name, location resurveyed) or if the site contains a new sampling location not previously submitted (e.g., new monitoring well installation). The columns marked "Required" must be reported for each row in the file. If they are not reported, the file will not load. Columns marked "If available" should also be reported.

3.1 Site Base Maps

Site base maps must be electronic CAD files in a DXF interchange format. The maps are to include all well locations, waste management units, landfills, buildings, and roads. Do not include any groundwater contours, contaminant contours, or other temporal type information. If the CAD file is available in real world locational coordinates, provide them along with a brief text description of the type of projection and datum used (UTM NAD 83 preferred). Also include text descriptions of the units and scale of the base map. The site base map file must be named according to the following convention:

SiteName.DXF

3.2 Site

Submitted once to define a site and provide the name, email address, and fax number of the main data contact. This file is required to be submitted as part of the initial EDD submittal. Each Site file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5SITE_v1.txt (or .csv)

Table 3-1. Site file data structure

Pos#	Column Name	Data Type	Required	Description
1	site_code	Text(3)	Required	Unique code for Operable Unit (site/area). Typically the code is "01" unless there is a second or third operable unit at facility. Code of "02" and "03" should be used for second and third unit, respectively. Contact the EPA RPM if unsure of proper code,.
2	facility_id	Text(20)	If available	EPA ID Code - Facility identifier code (see Appendix 7.1).
3	site_name	Text(30)	Required	Name of site.
4	site_task_code	Text(10)	If available	Code used to identify the task under which the site or area is investigated. This field is here for reference only. Field samples are formally associated with task codes.
5	site_desc1	Text(70)	If available	Site description, part one.
6	site_desc2	Text(70)	If available	Site description, part two.
7	contact_name	Text(50)	Required	Site contact name.
8	address1	Text(30)	Required	Site address, part one.
9	address2	Text(30)	If available	Site address, part two.

Table 3-1. Site file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
10	City	Text(30)	Required	Site city.
11	State	Text(2)	Required	Site state.
12	Zipcode	Text(10)	Required	Site zip code.
13	phone_number	Text(30)	Required	Site contact phone number.
14	alt_phone_number	Text(30)	If available	Alternative site phone number.
15	fax_number	Text(15)	If available	Site contact fax number.
16	email_address	Text(30)	Required	Site contact email address.

3.3 Location

Submitted to define the sampling locations for a site. This file is required to be submitted as part of the initial EDD submittal. Each row contains the definition of a unique sampling location. In the case of multiple wells located in one borehole, each well in the borehole will have the same sampling location identifier (sys_loc_code) and will be differentiated by a unique well identifier (sys_well_code), such as MW-01a, MW-01b, etc. An example of this case is presented in the Location File of Figure 2-3.

Each sampling location should only be reported once for a site. The only time data for a previously reported location is to be resubmitted is if a change occurs at the location such as the location being resurveyed. If the location is resurveyed and changes result to the coordinates and datum elevations, a new location file should be submitted with the location identifier, well identifier (if location is a well), and only the new updated data, <u>all other fields must be null</u>. The changes must be documented in an EDD submittal cover letter and the RPM should be notified. An example of a completed location file resulting from a resurvey is presented in Figure 2-3.

This file data structure incorporates the requirements of EPA's Locational Data Management Policy (LDP). LDP requires geographic coordinates and associated method, accuracy, and description codes for all environmental measurements collected by EPA employees, contractors, and grantees. A key premise of this policy is that secondary use of these data in geographic information systems (GIS) and statistical mapping programs are significant to the overall mission of the Agency. To facilitate the integration of data, EPA has established the LDP to standardize the coding of geologic coordinates and associated attributes. As a result, coordinates for each location must be reported in both universal transverse mercator (UTM) and in latitude and longitude with associated attributes.

<u>Note</u>: If the location being submitted is a monitoring well that has been installed more than one year from the EDD submittal date, the location table fields from Pos# 41, depth_to_top_of_screen, through Pos # 49, datum_start_date, are required to be populated. These fields are required to obtain the vertical location from which the groundwater sample was taken and the vertical location of the water table. If the location is not a well or is a well that has been installed within the last year, fields from Pos #41 through Pos #49 should be left null. These fields are a subset of the Geology files and for wells installed within the past year, will be captured within the Geology EDD files.

Each Location file must be named according to the following convention:
SiteNameDate.EPAIDCode.EPAR5LOC_v1.txt (or .csv)

Table 3-2. Location file data structure

Pos#	Column Name	Data Type	Required	Description
1	sys_loc_code	Text(20)	Required	Location identifier of sample collection, soil boring, or well installation. Examples of possible sys_loc_code are MW-01, A-1, SB6, etc. See Section 2.6 "Definition of a Facility, Site, and Location" for additional information.
2	sys_well_code	Text(20)	Required	Code used to differentiate between multiple wells in one boring. Code is the same as that used for sys_loc_code if single well, e.g., if sys_loc_code is MW-01 then sys_well_code is MW-01. Enter "NONE" if there is no well.
3	x_coord	Number w/decimal precision up to 15	Required	Sampling location numeric x UTM NAD83 coordinate in meters.
4	y_coord	Number w/decimal precision up to 15	Required	Sampling location numeric y UTM NAD83 coordinate in meters.
5	surf_elev	Number w/decimal precision up to 15	Required	Sampling location surface elevation in feet.
6	elev_unit	Text(15)	Required	Unit of measurement for elevations. Units must be in feet.
7	coord_sys_desc	Text(70)	Required	Sampling location coordinate system description. Must be UTM followed by appropriate zone number, i.e., UTM zone xx.
8	observation_date	Date	Required	Date observation or site survey was made.
9	alt_x_coord	Text(20)	Required	Longitude of sampling location in decimal degrees.
10	alt_y_coord	Text(20)	Required	Latitude of sampling location in decimal degrees.
11	coord_type_code	Text(20)	Required	Use "Lat Long." Code for the coordinate type used for alt_x and alt_y.
12	identifier	Text(20)	Required	For this EDD use "1." This field is a text identifier that facilitates unique representation of the coordinate system.
13	horz_collect_method_code	Text(2)	Required	Use codes in Appendix 7.3 horizontal collection method. Method used to determine the latitude/longitude.

Table 3-2. Location file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
14	horz_accuracy_value	Text(20)	Required	Accuracy range (+/-) of the latitude and longitude. Only the least accurate measurement should be reported, regardless if it is for latitude or longitude.
15	horz_accuracy_unit	Text(15)	Required	Use values in horizontal accuracy units valid value table, Appendix 7.4. Unit of the horizontal accuracy value.
16	horz_datum_code	Text(1)	Required	Use codes in horizontal datum valid value table, Appendix 7.5. Reference datum of the latitude and longitude.
17	elev_collect_method_code	Text(2)	Required	Use codes in elevation collection method valid value table, Appendix 7.6. Method used to determine the ground elevation of the sampling location.
18	elev_accuracy_value	Text(20)	If available	Accuracy range (+/-) of the elevation measurement.
19	elev_accuracy_unit	Text(15)	If available	Use values in unit valid value table, Appendix 7.18. Unit of the elevation accuracy value.
20	elev_datum_code	Text(1)	Required	Reference datum for the elevation measurement. Must use valid value from elevation datum table, Appendix 7.7
21	source_scale	Text(2)	Required	Scale of source used to determine the latitude and longitude. Must be a valid code from source scale code table, Appendix, 7.8. If GPS is used scale does not apply and "N" should be entered.
22	subcontractor_name_code	Text(10)	If available	Code used to distinguish subcontractor name.
23	verification_code	Text(1)	Not wanted	This field is only to be used by US EPA personnel.
24	reference_point	Text(50)	If available	Use codes in reference point valid value table, Appendix 7.2. Describes the place at which geologic coordinates were established.
25	geometric_type_code	Text(20)	If available	Code used to distinguish the geometric type of the location. For this EDD use "point."
26	rank	Long	Not wanted	This field is only to be used by US EPA personnel.
27	loc_name	Text(30)	If available	Sampling location name.
28	loc_desc	Text(70)	If available	Sampling location description.
29	loc_type	Text(10)	If available	Sampling location type. Use codes in loc_type valid value table, Appendix 7.9
30	loc_purpose	Text(20)	If available	Sampling location purpose.
31	primary_site_code	Text(20)	Required	Unique code for site or area. Must match site_code from Table 3-1: Site File Data Structure.

Table 3-2. Location file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
32	within_facility_yn	Text(1)	Required	Indicates whether this sampling location is within facility boundaries, "Y" for yes or "N" for no.
33	loc_county_code	Text(10)	If available	Location county code; controlled vocabulary using FIPS (Federal Information Processing Standard) codes. FIPS codes can be found via the internet at http://www.itl.nist.gov/fipspubs/ or http://www.oseda.missouri.edu/jgb/geos.html.
34	loc_district_code	Text(10)	If available	Location district code; controlled vocabulary using FIPS codes.
35	loc_state_code	Text(10)	If available	Location state code; controlled vocabulary using FIPS codes.
36	loc_major_basin	Text(10)	If available	Location major basin; controlled vocabulary using HUC (Hydrologic Unit Codes). HUC codes can be found via the internet at http://www.epa.gov/surf. The first 8 digits of the HUC code should be entered here.
37	loc_minor_basin	Text(10)	If available	Location minor basin; controlled vocabulary using HUC codes. Any digits after the 8th (first 8 are reported in loc_major_basin) should be reported here.
38	remark	Text(255)	If applic-able	Location specific comment.
39	total_depth	Number w/decimal precision up to 15	If available	Total depth below ground surface of boring, in feet.
40	depth_to_bedrock	Number w/decimal precision up to 15	If available	Depth below ground surface of bedrock in feet.
41	depth_to top_of_screen	Number w/decimal precision up to 15	Required if location is a well more than 1 year old	Depth in feet below ground surface to the top of the well screen. This information is required to obtain the vertical location from which the groundwater sample was taken. Leave null if sample is not from well or well is less than 1 year old. For wells less than 1 year old, info will be reported in geology files.

Table 3-2. Location file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
42	depth_to_bottom_of_screen	Number w/decimal precision up to 15	Required if location is a well more than 1 year old	Depth in feet below ground surface to bottom of well screen. This information is required to obtain the vertical location from which the groundwater sample was taken. Leave null if sample is not from well or well is less than 1 year old. For wells less than 1 year old, info will be reported in geology files.
43	top_casing_elev	Number w/decimal precision up to 15	Required if location is a well more than 1 year old	Elevation of the top of casing in feet. Leave null if sample is not from well or well is less than 1 year old. For wells less than 1 year old, info will be reported in geology files.
44	datum_value	Number w/decimal precision up to 15	Required if location is a well more than 1 year old	Value of datum used to reference water level measurements. Normally EPA uses the elevation of the top of well casing as the datum to reference water levels. Leave null if sample is not from well or well is less than 1 year old. For wells less than 1 year old, info will be reported in geology files.
45	datum_unit	Text (15)	Required if location is a well more than 1 year old	Use values from Unit valid value table, Appendix 7.18. Unit of measure for the well datum. Leave null if sample is not from well or well is less than 1 year old. For wells less than 1 year old, info will be reported in geology files.
46	step_or_linear	Text (6)	If appli-cable	Use only for re-surveys of well elevations. If a section of the well casing was removed or added use "step" as the value. If nothing was added or removed from the last survey use "linear" as the value.
47	datum_collect_method_code	Text (2)	Required if location is a well more than 1 year old	Use codes in elevation collection method valid value table, Appendix 7.6. Method used to determine the datum elevation.

Table 3-2. Location file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
48	datum_desc	Text(70)	Required if location is a well more than 1 year old	Description of the datum, such as "top of well casing." Leave null if sample is not from well or well is less than 1 year old. For wells less than 1 year old, info will be reported in geology files.
49	start_date	Date	Required if location is a well more than 1 year old	Date datum was first used. Leave null if sample is not from well or well is less than 1 year old. For wells less than 1 year old, info will be reported in geology files.

4. FORMATS FOR CHEMISTRY FILES

This section contains tables that define the file structures for the Chemistry EDD. The file structures include field measurement, chemistry sample, test/result, and water level. Please notice that some columns are "Not wanted" and only exist to comply with standard EQuIS® reporting formats. These columns should simply be reported as null values. The columns marked "Required" must be reported for each row in the file. If they are not reported, the data will not load. Columns marked "If available" should be submitted.

4.1 Chemistry Field Measurements

This file is used for *in situ* measurements taken in the field such as pH, conductivity, Eh, and dissolved oxygen, that are not associated with a sample but are associated with either a site or location. Also include measurements such as air temperature at the site. Data collected in the field that is associated with a sample, such as on site analysis using a mobile lab, should not use this file. Data associated with individual samples should be reported according to Section 4.2 and 4.3. Each Chemistry field measurement file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5CFM_v1.txt (or .csv)

Table 4-1. Chemistry field measurement file data structure

Pos#	Column Name	Data Type	Required	Description
1	table_name	Text (35)	Required	Enter "Location" if the measured parameter applies to a single location or "Site" if the measured parameter applies to a site.
2	sys_loc_code or site_code	Text (20)	Required	Enter a sys_loc_code if the measured parameter applies to a single location or a site_code if the it applies to a site.
3	param_code	Text (10)	Required	Use values in analyte valid value table, Appendix 7.10. These values were derived from the Chemical Abstracts Registry (CAS) Number for the parameter If available. Otherwise USAF ERPIMS PARLABEL were used.
4	measurement_date	Date	Required	Date of measurement.
5	measurement_time	Text (5)	Required	Time of measurement.
6	param_value	Text (20)	Required	Measured value.
7	param_unit	Text (15)	Required	Units that correspond to param_value.
8	measurement_method	Text (20)	If available	Method used to take measurement.
9	param_value_background	Text (20)	If available	Background value of measured parameter.
10	Remark	Text (255)	If available	Any comment and report measurement detection limit if applicable.
11	subcontractor_name_code	Text (10)	If available	Name of contractor.
12	worker_name	Text (50)	If available	Name of individual that took the measurement.
13	instrument_id	Text (50)	If available	Identifier for instrument used to take measurement.
14	calibration_date	Date	If available	Date that instrument was last calibrated.

4.2 Chemistry Sample

The Chemistry sample file contains data for samples collected at a site and location. The unique identifier for each sample is recorded in the sys_sample_code. Please record the sys_sample_code as TB+date for trip blank samples. For example a trip blank collected on April 5, 2000 would have a sys_sample_code of TB040500. A sys_sample_code of 'Trip Blank' is unacceptable because it cannot be distinguished from another trip blank labeled the same way. Each Chemistry sample file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5SMP_v1.txt (or .csv)

Table 4-2. Chemistry sample file data structure

Pos#	Column Name	Data Type	Required	Description
1	sys_sample_code	Text(20)	Required	Unique sample identifier. Each sample at a facility must have a unique value, including spikes and duplicates. You have considerable flexibility in the methods used to derive and assign unique sample identifiers, but uniqueness throughout the database is the only restriction enforced by EQuIS®.
2	sample_name	Text(30)	If available	Additional sample identification information as necessary. Is not required to be unique (i.e., duplicates are OK).
3	sample_matrix_code	Text(10)	Required	Code which distinguishes between different types of sample matrix. For example, soil samples must be distinguished from ground water samples, etc. Must use valid value from matrix table, Appendix 7.13.
4	sample_type_code	Text(10)	Required	Code which distinguishes between different types of samples. For example, normal field samples must be distinguished from laboratory method blank samples, etc. Must use valid value from sample_type table, Appendix 7.17.
5	sample_source	Text(10)	Required	This field identifies where the sample came from, either Field or Lab. In this import, this should always be Field.
6	parent_sample_code	Text(20)	Required for field duplicate samples	The value of "sys_sample_code" that uniquely identifies the sample that was the source of this sample. For example, the value of this field for a duplicate sample would identify the normal sample of which this sample is a duplicate.
7	sample_delivery_group	Text(10)	If available	EPA and their US EPA data providers are accustomed to using the CLP document definition of SDG. The CLP definition is more like a lab payment group, and is not the same as required by this specification. Automated data verification by EPA will be enhanced if an SDG is more like a "sampling event." For example, ground water samples should be put into a separate SDG from surface water samples to prevent flags associated with surface water matrix effects from being propagated to ground water results.
8	sample_date	Date	Required	Date sample was collected (in MM/DD/YYYY format for EDD).

Table 4-2. Chemistry sample file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
9	sample_time	Time	If available	Time of sample collection in 24-hr (military) HH:MM format.
10	sys_loc_code	Text(20)	Required*	Soil boring or well installation location. Must be a valid code for the facility and reported in the sys_loc_code field of the location file (Table 3-2). * Field should be null if field QC sample (e.g., field blank, trip blank, etc.)
11	start_depth	Number w/decimal precision up to 15	If applic-able	Beginning depth (top) of sample in feet below ground surface. Leave null for most ground water samples from monitoring wells. Database will derive this information from the start/end depth of the well screen field located in another data table. Only use for groundwater samples if discrete samples are taken at different depth elevations from a single well, i.e. multiple well packer samples.
12	end_depth	Number w/decimal precision up to 15	If applic-able	Ending depth (bottom) of sample in feet below ground surface. Leave null for most ground water samples from monitoring wells. Database will derive this information from the start/end depth of the well screen field located in another data table. Only use for groundwater samples if discrete samples are taken at different depth elevations from a single well, i.e. multiple well packer samples.
13	depth_unit	Text(15)	If applic-able	Use values from Unit valid value table, Appendix 7.18. Unit of measurement for the sample begin and end depths.
14	chain_of_custody	Text(15)	If available	Chain of custody identifier. A single sample may be assigned to only one chain of custody.
15	sent_to_lab_date	Date	If available	Date sample was sent to lab (in MM/DD/YYYY format for EDD).
16	sample_receipt_date	Date	If available	Date that sample was received at laboratory (in MM/DD/YYYY format for EDD).
17	sampler	Text(30)	If available	Name or initials of sampler.
18	sampling_company_code	Text(10)	Required	Name or initials of sampling company (not controlled vocabulary).
19	sampling_reason	Text(30)	Not wanted	Report as null.
20	sampling_technique	Text(40)	If available	Sampling technique.

Table 4-2. Chemistry sample file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
21	task_code	Text(20)	If available	Code used to identify the task under which the field sample was retrieved. The format for this field is XX-P#-##-##-####. Where XX is the type of task required (PR = Pre Remedial, RI = Remedial Investigation, FS = Feasibility Study, PD = Pre-Design, RD = Remedial Design, RA = Remedial Construction, PC = Post Construction, RM = Removal Action, BD = Before Dredge, AD = After Dredge, BR = Brown Fields, SP = Special Project), and P# is the phase, and ##-##-#### is the date in month, day and year.
22	collection_quarter	Text(5)	Not wanted	Report as null.
23	composite_yn	Text(1)	Required	Is sample a composite sample? "Y" for yes or "N" for no.
24	composite_desc	Text(255)	If available	Description of composite sample (if composite_yn is "Yes").
25	sample_class	Text(10)	not wanted	Report as null.
26	custom_field_1	Text(50)	not wanted	Report as null.
27	custom_field_2	Text(50)	not wanted	Report as null.
28	custom_field_3	Text(50)	not wanted	Report as null.
29	comment	Text(255)	If available	Report as null.

4.3 Chemistry Test/Results

The Chemistry Test/Results file contains data concerning analytical tests and results performed on samples. There are three files associated with test/result data: test/result data, test/result data with quality control (QC) data, and batch data. All data provided by PRPs are expected to be validated prior to submittal to EPA. Therefore the data fields containing QC data are not wanted and Table 4.3 should be submitted. Data provided by US EPA contractors typically are not validated prior to submittal to EPA and require that QC data be submitted using Table 4-4 and Table 4-5. When test/result data are to be submitted without QC data, populate and submit test/result data according to the data structure described in Table 4-3. If QC data are to be submitted with test/result data then populate and submit data according to the data structure described in Table 4-4. Batch data will only be submitted if test/result data with QC data are being submitted. If QC batch data are to be submitted, populate and submit batch data in accordance with
Table 4-5.

4.3.1 Chemistry Test/Results without QC

Populate and submit this file when no QC data are to be submitted. Each test/results file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5TRS_v1.txt (or .csv)

Table 4-3. Chemistry test/result file data structure

Pos#	Column Name	Data Type	Required	Description
1	sys_sample_code	Text(20)	Required	Unique sample identifier. Each sample at a facility must have a unique value, including spikes and duplicates. You have considerable flexibility in the methods used to derive and assign unique sample identifiers, but uniqueness throughout the database is the only restriction enforced by EQuIS®.
2	lab_anl_method_name	Text(35)	Required	Laboratory analytical method name or description. A controlled vocabulary column, valid values can be found in the appendix in table lab_anl_method_name.
3	analysis_date	Date	Required	Date of sample analysis in MM/DD/YYYY format. May refer to either beginning or end of the analysis as required by EPA.
4	analysis_time	Text(5)	Required	Beginning time of sample analysis in 24_hr (military) HH:MM format. Note that this field, combined with the "analysis_date" field is used to distinguish between retests and reruns (if reported). Please ensure that retests have "analysis_date" and/or "analysis_time" differ from the original test event (and fill out the test_type field as needed).
5	total_or_dissolved	Text(1)	Required	Must be either "D" for dissolved or filtered [metal] concentration, or "T" for everything else
6	column_number	Text(2)	Not wanted	Report as null.
7	test_type	Text(10)	Required	Type of test. Valid values include "initial," "reextract1," "reextract2," "reextract3," "reanalysis," "dilution1," "dilution2," and "dilution3."
8	lab_matrix_code	Text(10)	Required	Code which distinguishes between different type of sample matrix. For example, soil samples must be distinguished from ground water samples, etc. See matrix valid value table in Appendix 7.13. The matrix of the sample as analyzed may be different from the matrix of the sample as retrieved (e.g. leachates), so this field is available at both the sample and test level.
9	analysis_location	Text(2)	Required	Must be either "FI" for field instrument or probe, "FL" for mobile field laboratory analysis, or "LB" for fixed_based laboratory analysis.
10	Basis	Text(10)	Required	Must be either "Wet" for wet_weight basis reporting, "Dry" for dry_weight basis reporting, or "NA" for tests for which this distinction is not applicable. The EPA prefers that results are reported on the basis of dry weight where applicable.
11	container_id	Text(30)	Not wanted	Report as null.
12	dilution_factor	Number w/decimal precision up to 7	Required	Effective test dilution factor.

Table 4-3. Chemistry test/result file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
13	prep_method	Text(35)	If available	Laboratory sample preparation method name or description. Must use valid value from std_prep_method table, Appendix 7.14.
14	prep_date	Date	If available	Beginning date of sample preparation in MM/DD/YYYY format.
15	prep_time	Text(5)	If available	Beginning time of sample preparation in 24_hr (military) HH:MM format.
16	leachate_method	Text(15)	Required if Leached	Laboratory leachate generation method name or description. The method name should be sufficient to reflect operation of the laboratory (see analysis method discussion).
17	leachate_date	Date	Required if Leached	Beginning date of leachate preparation in MM/DD/YYYY format.
18	leachate_time	Text(5)	If available	Beginning time of leachate preparation in 24_hr (military) HH:MM format.
19	lab_name_code	Text(10)	Required	Unique identifier of the laboratory as defined by the EPA. Controlled vocabulary, see lab valid value table in the appendix.
20	qc_level	Text(10)	Required	May be either "screen" or "quant."
21	lab_sample_id	Text(20)	Required	Laboratory LIMS sample identifier. If necessary, a field sample may have more than one LIMS lab_sample_id (maximum one per each test event).
22	percent_moisture	Text(5)	If available	Percent moisture of the sample portion used in this test; this value may vary from test to test for any sample. Numeric format is "NN.MM," i.e., 70.1% could be reported as "70.1" but not as "70.1%."
23	subsample_ amount	Text(14)	If available	Amount of sample used for test.
24	subsample_ amount_unit	Text(15)	If available	Unit of measurement for subsample amount. Must use valid value from units table, Appendix 7.18.
25	analyst_name	Text(30)	Not wanted	Report as null.
26	instrument_id	Text(50)	Not wanted	Report as null.
27	comment	Text(255)	If available	Comments about the test as necessary.
28	preservative	Text(50)	If available	Sample preservative used.
29	final_volume	Text(15)	If available	The final volume of the sample after sample preparation. Include all dilution factors.
30	final_volume_unit	Text(15)	If available	The unit of measure that corresponds to the final_amount.
31	cas_rn	Text(15)	Required	Use values in analyte valid value table, Appendix 7.10.
32	chemical_name	Text(60)	Required	Use the name in the analyte valid value table, Appendix 7.10.
33	result_value	Text(20)	If available	Analytical result reported at an appropriate number of significant digits. May be blank for non_detects.
34	result_error_delta	Text(20)	If available	Error range applicable to the result value; typically used only for radiochemistry results.
35	result_type_code	Text(10)	Required	Must be either "TRG" for a target or regular result, "TIC" for tentatively identified compounds, "SUR" for surrogates, "IS" for internal standards, or "SC" for spiked compounds.

Table 4-3. Chemistry test/result file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
36	reportable_result	Text(10)	Required	Must be either "Yes" for results which are considered to be reportable, or "No" for other results. This field has many purposes. For example, it can be used to distinguish between multiple results where a sample is retested after dilution. It can also be used to indicate which of the first or second column result should be considered primary. The proper value of this field in both of these two examples should be provided by the laboratory (only one result should be flagged as reportable).
37	detect_flag	Text(2)	Required	Maybe either "Y" for detected analytes or "N" for non_detects. Use "Y" for estimated (above detection limit but below the quantitation limit) or ">" and "<" for tests such as flash point. Note that "<" must not be used to indicate non_detects (use "N" for non_detects instead).
38	lab_qualifiers	Text(7)	If available	Qualifier flags assigned by the laboratory. Must use valid value from the qualifiers table, Appendix 7.15.
39	validator_qualifiers	Text(7)	If available	Qualifier flags assigned by the validation firm. Must use valid value from the qualifiers table, Appendix 7.15.
40	organic_yn	Text(1)	Required	Must be either "Y" for organic constituents or "N" for inorganic constituents.
41	method_detection_ limit	Text(20)	not wanted	Report as null.
42	reporting_detection_ limit	Text(20)	If available	Concentration level above which results can be quantified with confidence. It must reflect conditions such as dilution factors and moisture content. Required for all results for which such a limit is appropriate. The reporting_detection_limit column must be reported as the sample specific detection limit.
43	quantitation_limit	Text(20)	Not wanted	Report as null.
44	result_unit	Text(15)	Required	Units of measurement for the result. Must use valid value from units table, Appendix 7.18.
45	detection_limit_unit	Text(15)	If available	Units of measurement for the detection limit(s). This field is required if a reporting_detection_limit is reported. Must use valid value from units table, Appendix 7.18.
46	tic_retention_time	Text(8)	Not wanted	Report as null.
47	result_comment	Text(255)	If available	Result specific comments.

4.3.2 Chemistry Test/Result with QC Data

The Chemistry test/results file contains data concerning analytical tests performed on samples with quality control data elements. This format is identical to the format of 4.3.1 except additional fields are available for QC data. This format is used only for data providers, mainly EPA contractors, that are submitting quality data elements with their reports. Each Chemistry test/results file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5TRSQC_v1.txt (or .csv)

Table 4-4. Chemistry test/results with QC data file structure

Pos#	Column Name	Data Type	Required	Description
1	sys_sample_code	Text(20)	Required	Unique sample identifier. Each sample at a facility must have a unique value, including spikes and duplicates. You have considerable flexibility in the methods used to derive and assign unique sample identifiers, but uniqueness throughout the database is the only restriction enforced by EQuIS.
2	lab_anl_method_ name	Text(35)	Required	Laboratory analytical method name or description. Must use valid value from lab_anl_method_name table, Appendix 7.11.
3	analysis_date	Date	Required	Date of sample analysis in MM/DD/YYYY format. May refer to either beginning or end of the analysis as required by EPA.
4	analysis_time	Text(5)	Required	Beginning time of sample analysis in 24_hr (military) HH:MM format. Note that this field, combined with the "analysis_date" field is used to distinguish between retests and reruns (if reported). Please ensure that retests have "analysis_date" and/or "analysis_time" differ from the original test event (and fill out the test_type field as needed).
5	total_or_dissolved	Text(1)	Required	Must be either "D" for dissolved or filtered [metal] concentration, or "T" for everything else.
6	column_number	Text(2)	Not wanted	Report as null.
7	test_type	Text(10)	Required	Type of test. Valid values include "initial," "reextract1," "reextract2," "reextract3," "reanalysis," "dilution1," "dilution2," and "dilution3."
8	lab_matrix_code	Text(10)	Required	Code which distinguishes between different type of sample matrix. For example, soil samples must be distinguished from ground water samples, etc. See matrix valid value table in Appendix 7.13. The matrix of the sample as analyzed may be different from the matrix of the sample as retrieved (e.g. leachates), so this field is available at both the sample and test level.
9	analysis_location	Text(2)	Required	Must be either "FI" for field instrument or probe, "FL" for mobile field laboratory analysis, or "LB" for fixed_based laboratory analysis.
10	basis	Text(10)	Required	Must be either "Wet" for wet_weight basis reporting, "Dry" for dry_weight basis reporting, or "NA" for tests for which this distinction is not applicable. The EPA prefers that results are reported on the basis of dry weight where applicable.
11	container_id	Text(30)	Required	Use the container ID for the sample bottle.
12	dilution_factor	Number w/decimal precision up to 7	Required	Effective test dilution factor.

Table 4-4. Chemistry test/results with QC data file structure (continued)

Pos#	Column Name	Data Type	Required	Description
13	prep_method	Text(35)	If available	Laboratory sample preparation method name or description. Must use valid value from std_prep_mthd table, Appendix 7.14.
14	prep_date	Date	If available	Beginning date of sample preparation in MM/DD/YYYY format.
15	prep_time	Text(5)	If available	Beginning time of sample preparation in 24_hr (military) HH:MM format.
16	leachate_method	Text(15)	Required if Leached	Laboratory leachate generation method name or description. The method name should be sufficient to reflect operation of the laboratory (see analysis method discussion).
17	leachate_date	Date	Required if Leached	Beginning date of leachate preparation in MM/DD/YYYY format.
18	leachate_time	Text(5)	If available	Beginning time of leachate preparation in 24_hr (military) HH:MM format.
19	lab_name_code	Text(10)	Required	Unique identifier of the laboratory as defined by the EPA. Controlled vocabulary, see lab valid value table in the appendix.
20	qc_level	Text(10)	Required	May be either "screen" or "quant."
21	lab_sample_id	Text(20)	Required	Laboratory LIMS sample identifier. If necessary, a field sample may have more than one LIMS lab_sample_id (maximum one per each test event).
22	percent_moisture	Text(5)	If available	Percent moisture of the sample portion used in this test; this value may vary from test to test for any sample. Numeric format is "NN.MM," i.e., 70.1% could be reported as "70.1" but not as "70.1%."
23	subsample_amount	Text(14)	If available	Amount of sample used for test.
24	subsample_amount_unit	Text(15)	If available	Unit of measurement for subsample amount. Must use valid values from units table, Appendix 7.18.
25	analyst_name	Text(30)	Not wanted	Report as null.
26	instrument_id	Text(50)	Not wanted	Report as null.
27	comment	Text(255)	If available	Comments about the test as necessary.
28	preservative	Text(50)	If available	Sample preservative used.
29	final_volume	Text(15)	If available	The final volume of the sample after sample preparation. Include all dilution factors.
30	final_volume_unit	Text(15)	If available	The unit of measure that corresponds to the final_amount.
31	cas_rn	Text(15)	Required	Use values in analyte valid value table, Appendix 7.10.
32	chemical_name	Text(60)	Required	Use the analyte name listed in the analyte valid value table, Appendix 7.10.
33	result_value	Text(20)	If available	Analytical result reported at an appropriate number of significant digits. May be blank for non_detects.
34	result_error_delta	Text(20)	If available	Error range applicable to the result value; typically used only for radiochemistry results.
35	result_type_code	Text(10)	Required	Must be either "TRG" for a target or regular result, "TIC" for tentatively identified compounds, "SUR" for surrogates, "IS" for internal standards, or "SC" for spiked compounds.

Table 4-4. Chemistry test/results with QC data file structure (continued)

Pos#	Column Name	Data Type	Required	Description
36	reportable_result	Text(10)	Required	Must be either "Yes" for results which are considered to be reportable, or "No" for other results. This field has many purposes. For example, it can be used to distinguish between multiple results where a sample is retested after dilution. It can also be used to indicate which of the first or second column result should be considered primary. The proper value of this field in both of these two examples should be provided by the laboratory (only one result should be flagged as reportable).
37	detect_flag	Text(2)	Required	Maybe either "Y" for detected analytes or "N" for non_detects. Use "Y" for estimated (above detection limit but below the quantitation limit) or ">" and "<" for tests such as flash point. Note that "<" must not be used to indicate non_detects (use "N" for non_detects instead).
38	Lab_qualifiers	Text(7)	If available	Qualifier flags assigned by the laboratory. Must use valid values from qualifier table, Appendix 7.15.
39	validator_qualifiers	Text(7)	If available	Qualifier flags assigned by the validation firm. This is a controlled vocabulary column, valid values can be found in the qualifiers table in appendix.
40	organic_yn	'Y' or 'N'	Required	Must be either "Y" for organic constituents or "N" for inorganic constituents.
41	method_detection_ limit	Text(20)	Not wanted	Report as null.
42	reporting_detection _limit	Text(20)	If available	Concentration level above which results can be quantified with confidence. It must reflect conditions such as dilution factors and moisture content. Required for all results for which such a limit is appropriate. The reporting_detection_limit column must be reported as the sample specific detection limit.
43	quantitation_limit	Text(20)	Not wanted	Report as null.
44	result_unit	Text(15)	Required	Units of measurement for the result. Controlled vocabulary, see Units valid value table in the appendix.
45	detection_limit_ unit	Text(15)	If available	Units of measurement for the detection limit(s). Controlled vocabulary, see Units valid value t able in the appendix. This field is required if a reporting_detection_limit is reported.
46	tic_retention_time	Text(8)	Not wanted	Report as null.
47	result_comment	Text(255)	If available	Result specific comments.
48	qc_original_conc	Text(14)	Required	The concentration of the analyte in the original (unspiked) sample. Might be required for spikes and spike duplicates (depending on user needs). Not necessary for surrogate compounds or LCS samples (where the original concentration is assumed to be zero).
49	qc_spike_added	Text(14)	Required	The concentration of the analyte added to the original sample. Might be required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample (depending on user needs).

Table 4-4. Chemistry test/results with QC data file structure (continued)

Pos#	Column Name	Data Type	Required	Description
50	qc_spike_measured	Text(14)	Required	The measured concentration of the analyte. Use zero for spiked compounds that were not detected in the sample. Might be required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample (depending on user needs).
51	qc_spike_recovery	Text(14)	Required	The percent recovery calculated as specified by the laboratory QC program. Always required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample. Report as percentage multiplied by 100 (e.g., report "120%" as "120").
52	qc_dup_original_ conc	Text(14)	Required	The concentration of the analyte in the original (unspiked) sample. Might be required for spike or LCS duplicates only (depending on user needs). Not necessary for surrogate compounds or LCS samples (where the original concentration is assumed to be zero).
53	qc_dup_spike_ added	Text(14)	Required	The concentration of the analyte added to the original sample. Might be required for spike or LCS duplicates, surrogate compounds, and any spiked and duplicated sample (depending on user needs). Use zero for spiked compounds that were not detected in the sample. Required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample. Also complete the qc-spike-added field.
54	qc_dup_spike_ measured	Text(14)	Required	The measured concentration of the analyte in the duplicate. Use zero for spiked compounds that were not detected in the sample. Might be required for spike and LCS duplicates, surrogate compounds, and any other spiked and duplicated sample (depending on user needs). Also complete the qc_spike_measured field.
55	qc_dup_spike_ recovery	Text(14)	Required	The duplicate percent recovery calculated as specified by the laboratory QC program. Always required for spike or LCS duplicates, surrogate compounds, and any other spiked and duplicated sample. Also complete the qc_spike_recovery field. Report as percentage multiplied by 100 (e.g., report "120%" as "120").
56	qc_rpd	Text(8)	Required	The relative percent difference calculated as specified by the laboratory QC program. Required for duplicate samples as appropriate. Report as percentage multiplied by 100 (e.g., report "30%" as "30").
57	qc_spike_lcl	Text(8)	Required	Lower control limit for spike recovery. Required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample. Report as percentage multiplied by 100 (e.g., report "60%" as "60").
58	qc_spike_ucl	Text(8)	Required	Upper control limit for spike recovery. Required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample. Report as percentage multiplied by 100 (e.g., report "120%" as "120").

Table 4-4. Chemistry test/results with QC data file structure (continued)

Pos#	Column Name	Data Type	Required	Description
59	qc_rpd_cl	Text(8)	Required	Relative percent difference control limit. Required for any duplicated sample. Report as percentage multiplied by 100 (e.g., report "25%" as "25").
60	qc_spike_status	Text(10)	Required	Used to indicate whether the spike recovery was within control limits. Use the "*" character to indicate failure, otherwise leave blank. Required for spikes, spike duplicates, surrogate compounds, LCS and any spiked sample.
61	qc_dup_spike_ status	Text(10)	Required	Used to indicate whether the duplicate spike recovery was within control limits. Use the "*" character to indicate failure, otherwise leave blank. Required for any spiked and duplicated sample.
62	qc_rpd_status	Text(10)	Required	Used to indicate whether the relative percent difference was within control limits. Use the "*" character to indicate failure, otherwise leave blank. Required for any duplicated sample.

4.3.3 Chemistry Batch Data

The Chemistry batch file contains data that relate the individual samples to the batch identifier. This table is normally only required if the data has not been validated. See Section 3.5. This allows EQuIS® to relate laboratory quality control samples with the field samples that were processed and analyzed together. This table has been structured to allow samples to have different batch IDs for the various phases of analysis (e.g., prep, analysis). The majority of samples will only have one batchID assigned by the laboratory. Each Chemistry batch file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5BAT_v1.txt (or .csv)

Table 4-5. Chemistry batch file data structure

Pos#	Column Name	Data type	Required	Description
1	sys_sample_code	Text(20)	Required	Unique sample identifier. Each sample must have a unique value, including spikes and duplicates. Laboratory QC samples must also have unique identifiers. The laboratory and the EQuIS® Chemistry user have considerable flexibility in the methods they use to derive and assign unique sample identifiers, but uniqueness throughout the database is the only restriction enforced by EquIS® Chemistry.
2	lab_anl_method_ name	Text(35)	Required	Laboratory analytical method name or description. A controlled vocabulary column, valid values can be found in the appendix in table ab_anl_method_name.
3	analysis_date	Date	If available	Date of sample analysis in MM/DD/YYYY format. May refer to either beginning or end of the analysis as required by EPA.

Pos#	Column Name	Data type	Required	Description
4	analysis_time	Text(5)	If available	Beginning time of sample analysis in 24_hr (military) HH:MM format. Note that this field, combined with the "analysis_date" field is used to distinguish between retests and reruns (if reported). Please ensure that retests have "analysis_date" and/or "analysis_time" differ from the original test event (and fill out the test_type field as needed).
5	total_or_dissolved	Text(1)	If available	Must be either "D" for dissolved or filtered [metal] concentration, or "T" for everything else
6	column_number	Text(2)	Not wanted	Report as null.
7	test_type	Text(10)	Required	Type of test. Valid values include "initial," "reextract1," "reextract2," "reextract3," "reanalysis," "dilution1," "diluton2," and "diluton3."
8	test_batch_type	Text(10)	Required	Lab batch type. Valid values include "Prep," "Analysis," and "Leach." This is a required field for all batches.
9	test_batch_id	Text(20)	Required	Unique identifier for all lab batches.

4.4 Water Level

The Water Level file contains information on water levels measured during sampling activities. It contains 17 fields that can be populated for each water level reading. Each water level file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5GWTR_v1.txt (or .csv)

Table 4-6. Water Level file data structure

Pos#	Column Name	Data Type	Required	Description
1	sys_loc_code	Text20	Required	Soil boring or well installation location. Must be a valid code for the facility and reported in the sys_loc_code field of the location file (Table 3-2).
2	sys_well_code	Text(20)	Required	Code used to differentiate between multiple wells in one boring. Code is the same as that used for sys_loc_code if single well, e.g., if sys_loc_code is MW-01 then sys_well_code is MW-01.
3	measurement_date	Date	Required	Date of water level measurement.
4	measurement_time	Time	Required	Time of water level measurement.
5	historical_ reference_elev	Number w/decimal precision up to 15	Required	Historical reference value. Used for the elevation of past reference points. Elevation must be in feet.
6	water_level_depth	Number w/decimal precision up to 7	Required	Depth of ground water below datum defined in well table (Table 5-3).
7	water_level_elev	Number w/decimal precision up to 7	If available	Elevation of water level. Elevation must be in feet.

Pos#	Column Name	Data Type	Required	Description
8	corrected_depth	Number w/decimal precision up to 7	If available	Depth of water level after any necessary corrections, e.g., if corrections were necessary to water_level_depth because free product was encountered.
9	corrected_elevation	Number w/decimal precision up to 7	If available	Corrected water level elevation. Elevation must be in feet.
10	measured_depth_of_well	Number w/decimal precision up to 7	If available	The depth below ground surface to the bottom of the well.
11	depth_unit	Text (15)	If available	Use values from unit valid value table, Appendix 7.18. Unit of measure for depths.
12	technician	Text (30)	If available	Name of technician measuring water level
13	dry_indicator_yn	Text (1)	If available	Is the well dry? "Y" for yes or "N" for no.
14	measurement_method	Text (20)	If available	Method used to make water level measurements.
15	batch_number	Text (10)	If available	Batch number of group of measurements.
16	dip_or_elevation	Text (10)	If available	Use either "elevation" or "dip." Use "elevation" if water level measurement is above the datum (i.e., artesian well) or "dip" if water level is below datum.
17	remark	Text (255)	If available	Remark on measurement.

5. FORMATS FOR GEOLOGY FILES

This section contains tables that define the file structures for the Geology EDD. The file structures include drilling activity, lithology, well, well construction, geology samples, water level, water table, and down hole point data. The columns marked "Required" must be reported for each row in the file. If they are not reported, the data will not load. The columns marked "If available" should also be reported. If the data are not available, report in the cover letter to the project RPM the data that is not available and the reason why.

Data providers are required to submit all applicable geology files for all monitoring wells installed less than one year from the Initial EDD submittal and for any wells installed in the future. Sites submitting Chemistry EDDs with sample data obtained from existing monitoring wells (wells greater than 1 year old) are *not required* to submit any Geology files. However, it is suggested that geology files be submitted for existing wells if the data are available.

5.1 Drill Activity

The drill activity file contains general information pertaining to the drilling activities resulting from the soil boring. Each drill activity file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5DRA_v1.txt (or .csv)

Table 5-1. Drill activity file data structure

Pos#	Column Name	Data Type	Required	Description
1	sys_loc_code	Text (20)	Required	Soil boring or well installation location. Must be a valid code for the facility and reported value in the sys_loc_code field of the location file (Table 3-2).
2	drill_event	Text (20)	Required	Used to identify drilling event. Examples of drilling events could be "initial" for initial drilling or "second" for a subsequent drilling at the same sys_loc_code .
3	start_depth	Number w/decimal precision up to 7	If available	The start depth, in feet below ground surface, of the drilling.
4	end_depth	Number w/decimal precision up to 7	If available	End depth, in feet below ground surface of the drilling.
5	start_date	Date	If available	Date drilling began.
6	diameter	Number w/decimal precision up to 7	If available	Diameter of boring.
7	diameter_unit	Text (15)	If available	Must use values from unit valid value table, Appendix 7.18. Unit of measure for diameter.
8	drill_method	Text (50)	If available	Method used to drill boring.
9	fluid	Text (50)	If available	Description of fluid used during drilling.

Table 5-1. Drill activity file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
10	viscosity	Text (50)	If available	Viscosity of drilling fluid.
11	hammer_wt	Text (50)	If available	Weight of hammer, in pounds, used for sampling.
12	hammer_fall	Text (50)	If available	Distance of hammer fall during sampling in inches.
13	lift_mechanism	Text (50)	If available	Type of mechanism used to lift hammer.
14	new_yn	Text (1)	If available	Is this a new boring? "Y" for yes or "N" for no.
15	repair_yn	Text (1)	If available	Is this drilling event to repair an existing boring? "Y" for yes or "N" for no.
16	deepen_yn	Text (1)	If available	Is this drilling event to deepen an existing boring? "Y" for yes or "N" for no.
17	abandon_yn	Text (1)	If available	Has the boring been abandoned? "Y" for yes or "N" for no.
18	replace_yn	Text (1)	If available	Is this boring event to replace an existing boring? "Y" for yes or "N" for no.
19	public_yn	Text (1)	If available	Is well being install for a public use? ? "Y" for yes or "N" for no.
20	purpose	Text (70)	If available	Describe the purpose of the boring event.

5.2 Lithology

The lithology file contains all the lithology data for the borings. It contains 16 fields that can be populated for each lithologic unit. Optional comments can be added to describe a depth specific observation within a lithologic unit. For example, you could describe a soil fracture that was noted at a depth of 15 feet within a clay unit. First completely describe the clay unit in a row of the lithologic file. Then add a row with only the sys_loc_code, start_depth (i.e., depth below ground surface of the fracture) and the remark1 and/or remark2 fields filled. Use the remark1 and/or remark2 fields to fully describe the fracture. All other fields on that line must be reported as null. An unlimited number of optional depth specific remarks can be added for each lithologic unit. Each lithology file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5LTH_v1.txt (or .csv)

Table 5-2. Lithology file data structure

Pos#	Column Name	Data Type	Required	Description
1	sys_loc_code	Text20	Required	Soil boring or well installation location. Must be a valid code for the facility and reported in the sys_loc_code field of the location file (Table 3-2).
2	start_depth	Number w/decimal precision up to 15	Required	The start depth, in feet below ground surface, of the lithologic unit.
3	material_type	Text(40)	If applic-able	The type of material that composes the lithologic unit. Controlled vocabulary, see material list in appendix. Must be used in all cases except when a depth specific comment is being made.

Table 5-2. Lithology file data structure

Pos#	Column Name	Data Type	Required	Description
4	geo_unit_code_1	Text(20)	If available	The data providers interpretation of the hydrogeologic unit present at this lithologic unit, e.g., aquifer 1, aquitard 1, aquifer 2, upper clay unit. See Appendix A.21, for example.
5	geo_unit_code_2	Text(20)	If available	Alternate geologic unit grouping. This can be a sub-classification of geologic_unit_code_1 or a layer used for groundwater flow/transport computer modelling that contains the lithologic unit. See Appendix A.21, for example.
6	remark_1	Text(255)	if applic-able	Comment on the lithologic unit.
7	remark_2	Text(255)	if applic-able	Additional comment on the lithologic unit.
8	moisture	Text(1)	If available	Was any moisture detected within the lithologic unit? "Y" for yes or "N" for no.
9	permeable	Text(10)	If available	Description of the permeability of the lithologic unit such as "impervious," "semi," "pervious," or "very."
10	consolidated_yn	Text(1)	If available	Was lithologic unit consolidated? "Y" for yes or "N" for no.
11	color	Text(20)	If available	Color of the lithologic unit.
12	observation	Text(255)	If available	General field observations of the lithologic unit.
13	consistency	Text(20)	If available	Description of the consistency of the soil such as very soft, soft, firm, hard or very hard.
14	sorting	Text(20)	If available	Geologic description of the grain size distribution of the lithologic unit. Use "poor" for soil with a wide range of particle sizes or "well" for soil with a narrow range of particle sizes.
15	grainsize	Text(20)	If available	Description of grain size.
16	odor	Text(20)	If available	Description of odor from the soil.

5.3 Well

The well file contains general information relating to well installation. Each well file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5WEL_v1.txt (or .csv)

Table 5-3. Well file data structure

Pos#	Column Name	Data Type	Required	Description
1	sys_loc_code	Text(20)	Required	Well installation location. Must be a valid code for the facility and reported in the sys_loc_code field of the location file (Table 3-2).
2	sys_well_code	Text(20)	Required	Code used to differentiate between multiple wells in one boring. Code is the same as that used for sys_loc_code if single well, e.g., if sys_loc_code is MW-01 then sys_well_code is MW-01.
3	well_description	Text(30)	If applic-able	Used for additional well description if necessary.
4	well_owner	Text(30)	If available	Name of entity that owns the well.
5	well_purpose	Text (20)	If available	Purpose of well.

Table 5-3. Well file data structure

Pos#	Column Name	Data Type	Required	Description
6	well_status	Text (20)	If available	Current status of well.
7	top_casing_elev	Number w/decimal precision up to 15	If available	Elevation of the top of well casing. Elevation must be in feet.
8	datum_value	Number w/decimal precision up to 15	Required	Value of datum used to reference water level measurements. EPA normally uses top of well casing for datum.
9	datum_unit	Text(15)	Required	Must use values from unit valid value table, Appendix 7.18. Unit of measure for the well datum.
10	datum_desc	Text (70)	Required	Description of the datum, such as "top of well casing."
11	step_or_linear	Text (6)	If available	Use only for re-surveys of well elevations. If a section of the well casing was removed or added use "step" as the value. If nothing was added or removed from the last survey use "linear" as the value.
12	start_date	Date	Required	Date that datum was first used.
13	datum_collect_ method_code	Text (2)	If available	Use codes in elevation collection method valid value table, Appendix 7.6. Method used to determine the datum elevation.
14	depth_of_well	Number w/decimal precision up to 15	If available	Depth below ground surface of the well bottom.
15	depth_unit	Text (15)	If available	Must use values from unit valid value table, Appendix 7.18. Unit of measurement for depth.
16	depth_measure_ method	Text (20)	If available	Method of measuring depth of well.
17	stickup_height	Text (8)	If available	Height of casing above ground surface.
18	stickup_unit	Text (15)	If available	Must use values from unit valid value table, Appendix 7.18. Unit of measure for the stickup height.
19	sump_length	Text (20)	If available	Length of sump.
20	sump_unit	Text (15)	If available	Must use values from unit valid value table, Appendix 7.18. Unit of measure for the sump length.
21	installation_date	Date	If available	Date of well installation.
22	construct_start_ date	Date	If available	Date well construction began.
23	construct_complete _date	Date	If available	Date well construction was completed.
24	construct_ contractor	Text (10)	If available	Name of contractor that installed well.
25	pump_type	Text (20)	If available	Type of pump used at well such as centrifugal, propeller, jet, helical, rotary, etc.
26	pump_capacity	Text (6)	If available	Capacity of pump.
27	pump_unit	Text (15)	If available	Must use values from unit valid value table, Appendix 7.18. Unit of measure for the pump capacity and yield.
28	pump_yield	Text (6)	If available	The yield of the pump.
29	pump_yield_ method	Text (20)	If available	Method used for pump yield.
30	weep_hole	Text (1)	If available	Is there a weep hole? "Y" for yes or "N" for no.

Table 5-3. Well file data structure (continued)

Pos#	Column Name	Data Type	Required	Description
31	head_configuration	Text (50)	If available	Description of the well head.
32	access_port_yn	Text (1)	If available	Is there an access port? "Y" for yes or "N" for no.
33	casing_joint_type	Text (50)	If available	Type of casing joint such as threaded, flush, or solvent welded.
34	perforator_used	Text (50)	If available	Description of well perforation such as slotted, drilled, or wound.
35	intake_depth	Number w/decimal precision up to 15	If available	Depth in feet below ground surface of the well intake.
36	disinfected_yn	Text (1)	If available	Was well disinfected? "Y" for yes or "N" for no.
37	historical_ reference_elev	Number w/decimal precision up to 15	If available	Historical reference value. Used for the elevation of past reference points. Elevation must be in feet. Elevation must be in feet.
38	geologic_unit_code	Text (20)	If available	Geologic unit in which the well intake is installed.
39	remark	Text (255)	If available	Available for general remarks.

5.4 Well Construction

The well construction file contains information relating to well construction and well segments. Information is required for all well segments within each well, including surface plug, protective casing, well casing, annular backfill, annular seal, screen, and filter pack. In order to obtain the depth of groundwater samples, it is particularly important that the depths of the top and bottom of the well screen be submitted for each well. Each well construction file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5WSG_v1.txt (or .csv)

Table 5-4. Well construction file data structure

Pos#	Column Name	Data Type	Required	Description
1	sys_loc_code	Text20	Required	Soil boring or well installation location. Must be a valid code for the facility and reported in the location file either now or during an earlier data submission.
2	sys_well_code	Text(20)	Required	Code used to differentiate between multiple wells in one boring. Code is the same as that used for sys_loc_code if single well, e.g., if sys_loc_code is MW-01 then sys_well_code is MW-01.
3	segment_type	Text(20)	Required	Use descriptions in well construction and materials valid value table, Appendix 7.20. Type of segment within well (e.g., protective casing, well casing, screen, etc.).
4	material_type_code	Text(20)	Required	Use descriptions in well construction and materials valid value table, Appendix 7.20. Material description of well segment.

Pos#	Column Name	Data Type	Required	Description
5	start_depth	Number w/decimal precision up to 15	Required	Depth, in feet below ground surface, of the top of the segment.
6	end_depth	Number w/decimal precision up to 15	Required	Depth, in feet below ground surface, of the bottom of the segment.
7	depth_unit	Text(15)	Required	The unit of depth measurements. Units must be feet.
8	inner_diameter	Number w/decimal precision up to 15	If available	The inside diameter of segment.
9	outer_diameter	Number w/decimal precision up to 15	If available	The outside diameter of the segment.
10	diameter_unit	Text(15)	If available	Must use values from unit valid value table, Appendix 7.18. The unit of diameter measurements.
11	thickness	Number w/decimal precision up to 15	If available	Thickness of the well segment.
12	thickness_unit	Text(15)	If available	Must use values from unit valid value table, Appendix 7.18. The unit of measurement for thickness.
13	slot_type	Text(20)	if applic-able	Type of slots such as bridge, shutter, and continuous.
14	slot_size	Number w/decimal precision up to 15	if applic-able	Width of slots.
15	slot_size_unit	Text(15)	if applic-able	Must use values from unit valid value table, Appendix 7.18. The unit of measurement for slot size.
16	perf_length	Number w/decimal precision up to 15	if applic-able	Length of perforated portion of screen.
17	screen_type	Text(15)	if applic-able	Type of screen.
18	material_quantity	Text(20)	If available	Quantity of material used in lbs. Applicable to annular seal/fill material.
19	material_density	Text(20)	If available	Density of the annular seal material in lbs/ft^3.
20	Remark	Text255	If available	Remarks regarding the segment.

5.5 Geology Samples

The Geology samples file contains geotechnical sample information. Samples collected for the purpose of analyte analysis should be reported using the Chemistry EDD. Each Geology sample file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5GSMP_v1.txt (or .csv)

Table 5-5. Geology samples file data structure

Pos#	Column Name	Data Type	Required	Description
1	sys_loc_code	Text20	Required	Sample collection location. Must be a valid code for the facility and reported in the sys_loc_code field of the location file (Table 3-2).
2	geo_sample_ code	Text(20)	Required	Unique sample identifier. Considerable flexibility is given in the methods used to derive and assign unique sample identifiers, but uniqueness throughout the database is the only restriction enforced.
3	sample_name	Text(50)	If available	Use to provide a name or description of sample. Does not have to be a unique throughout database.
4	sample_top	Number w/decimal precision up to 15	Required	Depth, in feet below ground surface, to top of sample.
5	sample_ bottom	Number w/decimal precision up to 15	Required	Depth, in feet below ground surface, to bottom of sample.
6	sampling_date	Date	If available	Date sample was collected.
7	sampling_time	Text(5)	If available	Time sample was collected in hh:mm.
8	sample_ method	Text(30)	If available	Method used to obtain sample, e.g., split spoon or Shelby tube.
9	material_type	Text(40)	If available	Material type of geologic sample. Must use valid value from geology soil materials table, Appendix 7.19.
10	sample_desc	Text(255)	If available	General description of the sample or sampling activities.
11	geologic_ unit_code	Text(20)	If available	Code used to identify the geologic unit of sample.
12	liquid_limit (LL)	Number w/decimal precision up to 7	If available	Liquid limit of sample.
13	plastic_limit (PL)	Number w/decimal precision up to 7	If available	Plastic Limit of sample.
14	shrinkage_ limit	Number w/decimal precision up to 7	If available	Shrinkage limit of sample.
15	flow_index	Number w/decimal precision up to 7	If available	Flow index of sample.
16	plasticity_ index	Number w/decimal precision up to 7	If available	Plasticity index of sample.

Table 5-5. Geology samples file data structure

Pos#	Column Name	Data Type	Required	Description
17	activity	Number w/decimal precision up to 7	If available	Activity of sample.
18	E	Number w/decimal precision up to 7	If available	Void ratio of sample.
19	e_max	Number w/decimal precision up to 7	If available	Maximum void ratio of sample.
20	e_min	Number w/decimal precision up to 7	If available	Minimum void ratio of sample.
21	N	Number w/decimal precision up to 7	If available	Porosity of sample.
22	specific_ gravity	Number w/decimal precision up to 7	If available	Specific gravity of sample.
23	W	Number w/decimal precision up to 7	If available	Water content of sample.
24	opt_w	Number w/decimal precision up to 7	If available	Optimum water content.
25	S	Number w/decimal precision up to 7	If available	Degree of saturation of the sample.
26	K	Number w/decimal precision up to 7	If available	Hydraulic conductivity of sample.
27	K_unit	Number w/decimal precision up to 7	If available	Use unit valid value table in appendix. Unit of measure for K.
28	unit_wt	Number w/decimal precision up to 7	If available	Unit weight of sample.
29	sat_unit_wt	Number w/decimal precision up to 7	If available	Saturated unit weight.
30	dry_unit_wt	Number w/decimal precision up to 7	If available	Dry unit weight.
31	dry_unit_wt_ max	Number w/decimal precision up to 7	If available	Maximum dry unit weight.
32	dry_unit_wt_mi n	Number w/decimal precision up to 7	If available	Minimum dry unit weight.
33	density_unit	Number w/decimal precision up to 7	If available	Must use values from unit valid value table, Appendix 7.18. Unit of measure for the densities of the sample.

Table 5-5. Geology samples file data structure

Pos#	Column Name	Data Type	Required	Description
34	rel_density	Number w/decimal precision up to 7	If available	Relative density of sample.
35	rel_ compaction	Number w/decimal precision up to 7	If available	Relative compaction of sample.
36	consistency	Text (20)	If available	Description of the consistency of the soil sample such as very soft, soft, firm, hard or very hard.
37	organic_ carbon	Number w/decimal precision up to 7	If available	Organic carbon content of sample.
38	organic_ carbon_unit	Text (15)	if available	Must use values from unit valid value table, Appendix 7.18. Unit of measurement of organic content.

5.6 Water Level

The Water Level file contains information on water levels measured from the soil borings or wells. It contains twelve fields that can be filled in for each water level reading. This file is to be submitted once with the initial geology files. All recurring water level information should be submitted with the Chemical files using the proper file name described in Section 4.

Each Water Level file must be named according to the following convention:
SiteNameDate.EPAIDCode.EPAR5GWTR_v1.txt (or .csv)

Table 5-6. Water Level file data structure

Pos#	Column Name	Data Type	Required	Description
1	sys_loc_code	Text20	Required	Soil boring or well installation location. Must be a valid code for the facility and reported in the sys_loc_code field of the location file (Table 3-2).
2	sys_well_code	Text(20)	Required	Code used to differentiate between multiple wells in one boring. Code is the same as that used for sys_loc_code if single well, e.g., if sys_loc_code is MW-01 then sys_well_code is MW-01.
3	measurement_date	Date	Required	Date of water level measurement.
4	measurement_time	Time	Required	Time of water level measurement.
5	historical_referenc e_elev	Number w/decimal precision up to 15	Required	Historical reference value. Used for the elevation of past reference points. Elevation must be in feet.
6	water_level_depth	Number w/decimal precision up to 7	Required	Depth of ground water below datum defined in well table (Table 5.3).
7	water_level_elev	Number w/decimal precision up to 7	if available	Elevation of water level. Elevation must be in feet.

Table 5-6. Water Level file data structure

Pos#	Column Name	Data Type	Required	Description
8	corrected_depth	Number w/decimal precision up to 7	If available	Depth of water level after any necessary corrections, e.g., if corrections were necessary to water_level_depth because free product was encountered.
9	corrected_elevation	Number w/decimal precision up to 7	If available	Corrected water level elevation. Elevation must be in feet.
10	measured_depth_of_well	Number w/decimal precision up to 7	If available	The depth below ground surface to the bottom of the well.
11	depth_unit	Text (15)	If available	Must use values from unit valid value table, Appendix 7.18. Unit of measure for depths.
12	technician	Text (30)	If available	Name of technician measuring water level.
13	dry_indicator_yn	Text (1)	if available	Is the well dry? "Y" for yes or "N" for no.
14	measurement_method	Text (20)	if available	Method used to make water level measurements.
15	batch_number	Text (10)	If available	Batch number of group of measurements.
16	dip_or_elevation	Text (10)	If available	Use either "elevation" or "dip." Use "elevation" if water level measurement is above the datum (i.e., artesian well) or "dip" if water level is below datum.
17	remark	Text (255)	If available	Remark on measurement.

5.7 Water Table

The water table file stores data pertaining the water table. Each water table file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5TBL_v1.txt (or .csv)

Table 5-7. Water table file data structure

Pos#	Column Name	Data Type	Required	Description
1	Sys_loc_code	Text (20)	Required	Soil boring or well installation location. Must be a valid code for the facility and reported in the sys_loc_code field of the location file (Table 3-2).
2	type	Text (20)	Required	Aquifer designation such as unconfined1, confined1, or confined2.
3	sequence	Text (20)	Required	Designation of when water level measurement was taken. For example, measurement before water stabilized would be "unstabilized" and after stabilization would be "stabilized."
4	depth	Number w/decimal precision up to 15	Required	Depth of water table, in feet, below reference point.
5	flowing_yn	Text (1)	If available	Is the water table flowing? "Y" for yes or "N" for no.
6	measurement_method	Text (50)	If available	Method of measuring water table depth.

Table 5-7. Water table file data structure

Pos#	Column Name	Data Type	Required	Description
7	capped_pressure	Number w/decimal precision up to 15	If available	Hydrostatic pressure of confined aquifer.
8	capped_pressure_ unit	Text (15)	If available	Use values from Unit valid value table. Unit of measure for capped pressure.
9	reference_point	Text (50)	If available	Description of reference point from which depth were measured.
10	reference_elevation	Number w/decimal precision up to 15	Required	The reference point elevation. Elevation must be in feet.
11	temperature	Number w/decimal precision up to 15	If available	Temperature of water in the water table.
12	temperature_unit	Text (15)	If available	Must use values from unit valid value table, Appendix 7.18. Unit of temperature.

5.8 Geology Down Hole Point Data

The Geology down hole point data file stores data from down hole logging methods such as Cone Penetrometer Tests and geophysics. All down hole logging data should be submitted. Report the parameter being measured in the "param" field, such as resistivity, and report the measured value at the depth of the measurement. Table 5-8 presents the file structure and Table 5-9 gives an example a down hole point file ready to be converted to a text file. Each Geology down hole point data file must be named according to the following convention:

SiteNameDate.EPAIDCode.EPAR5DHP_v1.txt (or .csv)

Table 5-8. Geology Down Hole Point File Data Structure

Pos#	Column Name	Data Type	Required	Description
1	Sys_loc_code	Text20	Required	Sample collection location. Must be a valid code for the facility and reported in the sys_loc_code field of the location file (Table 3-2).
2	Depth	Number w/decimal precision up to 15	Required	Depth of measurement below ground surface in feet.
3	Param	Text(20)	Required	The parameter being measured such as tip stress, resistivity, or pore pressure.
4	param_value	Number w/decimal precision up to 15	Required	The measured value of the parameter.

Table 5-9. Example of down hole point data file

Sys_loc_code	Depth	Param	Param_Value
MW01	10.8	Tip Stress	612
MW01	11.2	Tip Stress	624
MW01	10.8	Sleeve Stress	6.1
MW01	11.2	Sleeve stress	5.8
MW02	9.5	Resistivity	510
MW02	10.1	Resistivity	521
MW02	11.0	Resistivity	889

6. TECHNICAL SUPPORT

EPA Region 5 provides technical support for users of this EDD. For questions concerning data, data formats, and submission procedures please contact X at Y. For questions relating to the quarterly groundwater modeling program, please contact your site RPM.

Health & Safety Plan

HALEY & ALDRICH, INC.

SITE-SPECIFIC HEALTH & SAFETY PLAN

for

Delphi Plant 400

Flint, MI

Project/File No. 49017-007

Prepared by: Ban N. Shamoon Date: March 2003

Revised by: Chris L. Merrifield Date: March 2003

APPROVALS: The following signatures constitute approval of this Health & Safety Plan. Deviations from this Plan are not permitted without prior approval from the undersigned.

Chris L. Merrifield - Office H&S Coordinator	Date
Lloyd S. Ross - Site/Project Manager	Date
Chris L. Merrifield - Corporate H&S Manager	Date

PRE-WORK HEALTH & SAFETY BRIEFING

I have attended a briefing on this Health & Safety Plan prior to the start of on-site work and declare that I understand and agree to follow the provisions and procedures set forth herein while working on this site.

PRINTED NAME	SIGNATURE	DATE

NOTE: This Site Health and Safety Plan provides only site-specific descriptions and work procedures. General safety and health compliance programs in support of this site plan, including safe work, training, medical monitoring, and recordkeeping practices, are described in the Haley & Aldrich Corporate Health and Safety Program Manual and are hereby made part of this plan by reference. The manual is available to all employees and to outside parties by request.

1.0 PROJECT INFORMATION

Name of Project: RFI Activities	**H&A File No.:** 49017-017
Location: Flint, MI	
Client/Site Contact: Alton Putney	**Contact Phone No.:** 810.257.5547
H&A Project Manager: Lloyd S. Ross	**PM Phone No.:** 216.739.0555

SCOPE OF WORK:

- Site Wide Geoprobe installation and soil and groundwater characterization
- Geoprobe installation (southwest portion of Site) and groundwater characterization
- Sump inspection

Subcontractor(s) to be involved in on-site activities:

Name	Work Activity

Projected Start Date:

Projected Completion Date:

Estimated Number of Days to Complete Field Work:

2.0 SITE DESCRIPTION

Check one of the following:

Site classification:	X	Industrial		Commercial		Other:

2.1 General Description: (include site history/usage; type of facility; type of investigation; materials stored/used on site; whether paved or landscaped, etc.)

The Site was first developed in the early-1900s. The first structures were constructed on the northwestern portion of the Site and housed ceramics manufacturing operations. These early operations evolved into manufacturing of automobile components. The manufacturing plant expanded over time and grew to roughly its current configuration by the 1950s.

Automobile components have been manufactured at the site since early in its history. The automotive products manufactured at the Site have included spark plugs, bumpers, dashboard components, fuel system components, and filter components. Currently the plant produces spark plugs and automotive fuel pumps.

Site Status (mark all that apply):

X	Active		Inactive
	Partially Active		Other:

Site history information sources used; check all that apply:

	City Directories		Sanborn Maps
X	Geological References		State Files
X	Previous report by H&A		Water Quality Maps
X	Previous report by others		Inquiries

Is a **site plan** or sketch available? Y_X_ N__ If yes, attach a copy to this plan.

Indicate any **unusual features** at the site (power lines, variable terrain, etc.):

2.2 Work Areas

List/identify each specific work area(s) on the job site and indicate its location(s) on the site plan:

3.0 PROJECT TASK BREAKDOWN

List and describe each distinct work task below:

Task No.	Task Description	Employee(s)	Work Date(s) or Duration

SUMMARY OF HAZARDS AND REQUIRED PPE

Task No.	Chemical Hazards	Physical Hazards	Required PPE

4.0 HAZARD ASSESSMENT

4.1 Chemical Hazards

Is **chemical analysis data** available? Y_X_ N_ (If yes, a data summary should be attached)

Does chemical analysis data indicate that the site is contaminated? Y_X_ N __

Potential **physical state** of the hazardous materials at the site (mark all that apply):

X	Gas/Vapor	X	Sludge
X	Liquid	X	Solid/Particulate

Anticipated/actual **class of compounds** (mark all that apply):

	Asbestos		Inorganics
X	BTEX		Pesticides
X	Chlorinated Solvents	X	Petroleum products
X	Heavy Metals		Other:

Impacted environments (indicate all media in which contamination is expected):

X	Air	X	Groundwater
X	Soil		Sediment
	Surface water		Other:

Estimated concentrations/medium of major chemicals expected to be encountered by onsite personnel:

Work Activity	Media	Chemical	Anticipated Concentration

(Media key: A = Air; GW = Groundwater; SW = Surface Water; SO = Soil; SE = Sediment)

Other site (safety) concerns related to the chemicals present on this site:

4.2 Physical Hazards

Is any site work area(s) to be entered for this project considered a confined space? Y___N _X_

If yes, indicate which area(s) and why:

ALL CONFINED SPACE ENTRIES REQUIRE SPECIAL PROCEDURES, PERMITS AND TRAINING AND MUST BE APPROVED BY THE CORPORATE HEALTH & SAFETY MANAGER

Physical Hazard Checklist

Indicate all hazards that may be present for each task. If any of these potential hazards are checked, it is the project manager's responsibility to determine how to eliminate/minimize the hazard to protect onsite personnel. Note: Task numbers refer to those identified in section 3.

(Highlight the check mark [√], copy and paste in the appropriate box)

Hazards	Task 1	Task 2	Task 3	Task 4	Task 5
Underground utilities					
Overhead utilities					
Excavations greater than 4' depth					
Open excavation fall hazards					
Heavy equipment					
Drilling hazards					
Noise (above 85 dBA)					
Traffic concerns					
Extreme weather conditions					
Rough terrain for drilling equipment					
Buried drums					
Heavy lifting (more than 50 lbs)					
High risk fire hazard					
Poisonous insects or plants					
Water hazards					
Use of a boat					
Lockout/Tagout requirements					
Other:					

Describe any special precautions to be taken with respect to the hazards checked above:

MISS DIG will be notified to clear underground utilities. Personal protective equipment will be worn to prevent from injuries from heavy equipment and drilling hazards.

5.0 PROTECTIVE MEASURES

5.1 Personal Protective Equipment Requirements

PPE Checklist

(Highlight the check mark [√], copy and paste in the appropriate box)

Required PPE	Task 1	Task 2	Task 3	Task 4	Task 5
Hard hat					
Safety glasses w/side shields					
Steel-toe footwear					
Hearing protection (plugs, muffs)					
Tyvek ™ coveralls					
PE-coated Tyvek™ coveralls					
Boots, chemical resistant					
Boot covers, disposable					
Leather work gloves					
Inner gloves -					
Outer gloves -					
Tape all wrist/ankle interfaces					
Half-face respirator					
Full-face respirator					
Organic vapor cartridges					
Acid gas cartridges					
Other cartridges:					
P-100 (HEPA) filters					
Face shield					
Other:					
Level of protection required [C or D]:	**D**	**D**	**D**		

Standby equipment to be available onsite: NA

5.2 Personal Hygiene Safeguards

Safety glasses are required at all times inside the plant.

Smoking is only allowed is designated areas.

Prior to eating, smoking, or leaving the site for the day, hands will be washed thouroughly.

5.3 Site Safety Equipment

Check all items that are required to be on site:

X	Fire extinguisher	X	First aid kit		Flashlight
X	Air horn/Signaling device	X	Cellular phone		Duct tape
	Ladder		Barricade tape		Drum dolly
	Personal flotation devices	X	Safety cones		Harness/Lanyard
	Other, specify:				

5.4 Site Security & Work Area Controls

Access to each contaminated work area will be controlled during on-site activities as follows:

Post Work/Warning Signs

Designated No Smoking Areas

Site Control/Decontamination Areas
Exclusion Zone-20 feet from sampling area
Contamination Reduction Zone-40 feet from sampling area (Decontamination Zone)
Support Zone-All areas delineated beyond the Contamination Reduction Zone

Can **site access** be controlled by a perimeter fence or similar means? Y __X_ N ___

If not, how will the site/work area be controlled during non-work hours to prevent access by unauthorized persons?

6.0 MONITORING PLAN AND EQUIPMENT

Is air/**exposure monitoring** required at this work site for personal protection? Y __ N _X_

Is **perimeter monitoring** required for community protection? Y __ N _X_

Monitoring/Screening equipment required to be on site:

X	HNu analyzer (PID)		10.2eV		11.7eV		Combustible Gas Indicator (CGI) (LEL)
	Organic vapor monitor (FID)						Multiple Gas Detector - LEL/O_2/H_2S/CO
	Photovac Micro Tip, 10.6eV						Dust/Aerosol/Fiber count monitor
	Photovac GC						Colorimetric tubes; Specify:
	Other:						

Standard action levels and required responses for readings obtained with a multiple gas detector or an individual monitoring instrument are listed below. Do not deviate from these guidelines unless granted specific approval from the Corporate Health and Safety Manager.

Instrument	Normal	Operating levels	Action levels – required responses
Oxygen Meter	20.9%	Between 19.5-23.5%	Below 19.5 %: leave area, requires supplied air Above 23.5%: leave area, fire hazard
CGI	0%	Less than 10%	Greater than 10%: fire/explosion hazard; cease work
Hydrogen Sulfide	0%	Less than 10 ppm.	Greater than 15 ppm (or 10 ppm for 8 hrs) requires supplied air respirator (SAR)
Carbon Monoxide	0%	Less than 25 ppm	Greater than 200 ppm for 1 hour or 25 ppm for 8 hrs requires SAR

Description of Monitoring Requirements (include frequency and location by Task):

Monitoring Plan for Task Number(s):	1-2	Frequency:	2-4	times per	hour

Breathing Zone/Source – Continuous monitoring if near action level

Monitoring Plan for Task Number(s):	3	Frequency:	2	times per	hour

Perimeter – Every 30 minutes if detection in breathing zone.

Monitoring Plan for Task Number(s):		Frequency:		times per	

Notes: 1. Exposure Guidelines for common contaminants are listed in **Table 1 (attached)**.
2. Requirements for PPE upgrades based on monitoring are in **Table 2 (attached)**.
3. Record monitoring data and PPE upgrades on **Record of Field Monitoring** form **(attached)**; maintain with project files.

7.0 DECONTAMINATION

7.1 Personnel Decontamination

Are **decontamination procedures** required for personnel working on site? Y _X__ N ___
If yes, describe steps:
1. Remove gloves
2. Dispose of PPE in disposable bags

Location of decontamination station:
40 feet from sampling area

Disposal of PPE:
Dispose of all PPE in disposable bags

7.2 Tools & Equipment Decontamination

Check all **equipment and materials needed for decontamination** of tools and other equipment:

	Acetone	X	Distilled water		Poly sheeting
X	Alconox soap		Drums for water		Steam cleaner
X	Brushes		Hexane	X	Tap water
X	Disposal bags		Methanol	X	Washtubs
	Other, specify: disposable bags, paper towels				

Outline the **equipment decontamination procedures** for this project:

1. See Standard Operating Procedure 7.0 in the Field Sampling Plan for Decontamination Procedures.

Disposal methods for contaminated decontamination materials (e.g., wash water, rags, brushes, poly sheeting) will consist of:

Dispose of PPE in disposal bags.

8.0 CONTINGENCY PLAN

EMERGENCY RESPONSE RESOURCES

Nearest Hospital: (see attached map) Address: Phone Number:	Genesys Regional Medical Center 802 Kensington Avenue Flint, MI 48503 810.762.8710
Emergency Response Number:	**911**
Local Emergency Response Number (if not on 911 system):	
Poison Control: Michigan Department of Community Health: Genesee County Health Department: Michigan DEQ Shiawasee District Office:	800.222.1222 517.373.3500 810.257.3612 517.625.5515
Occupational Health Physician: Address: Phone Number: Emergency Phone Number:	Dr. Dean Erickson, M.D. M.P.H. Med Center 8555 Sweet Valley Drive Valley View, Ohio 44125 216.328.2240
Haley & Aldrich Project Manager: Phone Number: Emergency Phone Number: Client Contact/Project Manager: Phone Number: Emergency Phone Number:	Lloyd S. Ross Non-responsive [redacted] Alton Putney Non-responsive [redacted]
Other Entity: Address: Phone Number:	

Evacuation alarms and/or emergency information be communicated among personnel on site by the following means: __ Verbal communication. If communication will be by other means, describe:

Emergency services will be summoned: ___ Via on-site phone. If contact will be by other means, describe:

The **site evacuation plan** is as follows: Available at Plant

TABLE 1
HAZARD MONITORING

Constituents of Concern (Circle)	Routes Of Exposure	IDLH (ppmV)	PEL (ppmV)	TLV (ppmV)	PID (eV)	FID (ppmV)	Odor Threshold	Irritation Threshold	Odor Description
Acetone	R,I,C	20000	750	750	9.69	60	13	---	Chem, sweet, pungent
Benzene	R,A,I,C	Ca	1	10	9.25	150	4.68	---	Solvent
Carbon tetrachloride	R,A,I,C	Ca	2	Skin 5	11.47	10	50	---	Sweet, pungent
Chlorobenzene	R,I,C	2400	75	75	9.07	200	0.68	---	Almond like
Chloroform	R,I,C	Ca	2	10	11.42	65	50	E4096	Sweet
Cyanides (as CN)	R,A,I,C	50 mg/m³	5 mg/m³	5 mg/m³	---	---	---	---	Faint almond odor
o-Dichlorobenzene	R,A,I,C	1700	Cv30	Cv30	9.06	50	0.3	E 20-30	Pleasant, aromatic
p-Dichlorobenzene	R,I,C	1000	75	75	8.94	---	0.18	E 80-160	Distinct, aromatic mothball-like
1,1-Dichloroethane	R,I,C	3000	100	200	11.06	80	200	---	Distinct
1,2-Dichloroethane	R,I,A,C	Ca	1	10	11.12	80	88	---	Chloroform
1,1-Dichloroethylene	R,I, A, C	Ca	1	5	10.00	40	190	---	---
1,2-Dichloroethylene	R,I,C	1000	200	200	9.65	50	0.085	---	Ether-like, acrid
Ethanol	R,A,I,C	---	1000	1000	10.48	25	10	---	Sweet
Ethylbenzene	R,I,C	2000	100	100	8.76	100	2.3	E 200	Aromatic
Ethylene Glycol vapor	R,A,I,C	---	Cv 50	Cv 50	---	---	---	---	---
Formaldehyde	I,C	Ca	3	1	10.88	---	0.83	E 0.5	Hay
Gasoline	R,I,C	---	300	300	---	---	---	---	---
Hexane, n-isomer	R,I,C	5000	50	50	10.18	70	130	E.T 1400-1500	Mild, gasoline-like
Hydrogen Cyanide (as CW)	R,A,I,C	50	10	SkCv-10	13.69	---	0.58	---	Bitter almonds
Methanol	R,I,C	25000	Sk 200	Sk 200	10.84	12	1000	---	Sweet

Constituents of Concern (Circle)	Routes Of Exposure	IDLH (ppmV)	PEL (ppmV)	TLV (ppmV)	PID (eV)	FID (ppmV)	Odor Threshold	Irritation Threshold	Odor Description
MEK	R,I,C	3000	200	200	9.48	80	5.4	---	Acetone-like
Methyl Chloroform (1,1,1-TCA)	R,I,C	700	350	350	11.0	105	20-100	---	Chloroform-like
Methylene Chloride	R,I,C	Ca	500	50	11.35	100	25-50	E 5000	Ether-like
Methyl Mercaptan	R,C	400	Cv 0.5	0.5	9.44	---	---	---	Garlic, Rotten Cabbage
MIBK (Hexone)	R,I,C	3000	50	50	---	---	---	---	Pleasant
Naptha (coal tar)	R,I,C	10000	100	---	---	---	---	---	Aromatic
Naphthalene	R,A,I,C	500	10	10	8.14	---	0.3	E 15	Mothball-like
Octane	R,I,C	5000	300	300	9.9	80	48	---	Gasoline-like
Pentachlorophenol	R,A,I,C	150mg/m³	0.5mg/m³sk	0.5mg/m³sk	---	---	---	---	Pungent when hot
Phenol	R,A,I,C	250	Sk5	Sk5	8.5	---	0.04	E.N.T 68	Medicinal
Propane	R,C	20000	1000	Asphyx.	10.95	80	16000	---	Natural gas odor
Stoddard Solvent (Mineral Sprits)	R,CI,I	5000	100	100	*	---	1	E 400	Kerosene-like
1,1,2,2-Tetrachloroethane	R,A,I,C	Ca	Sk1	1	11.1	100	1.5	---	---
Tetrachloroethylene	R,I,C	Ca	25	50	9.32	70	4.68	N.T513-690	Ether, Chloroform-like
Toluene	R,A,I,C	2000	100	100	8.82	110	2.14	E 300-400	Mothballs
Trichloroethylene (TCE)	R,A,I,C	Ca	100	50	9.47	70	21.4	---	Solventy, chloroform-like
Turpentine	R,A,I,C	1900	100	100	---	---	200	E.N 200	Pine like
Vinyl Chloride (VC)	R	Ca	1	5	9.995	---	3000	---	Ethereal
Xylenes	R,A,I,C	1000	100	100	8.56/8.44	111/116	1.1	E.N.T. 200	Aromatic
Asbestos	R	Ca	0.2fibr/cc	0.2fibr/cc	---	---	---	---	---
Dichlorodifluoromethane (Freon 12)	R,C	50000	1000	1000	11.97	15	---	---	---

Constituents of Concern (Circle)	Routes Of Exposure	IDLH (ppmV)	PEL (ppmV)	TLV (ppmV)	PID (eV)	FID (ppmV)	Odor Threshold	Irritation Threshold	Odor Description
Hydrogen peroxide	R,I,C	75	1	1	11	---	---	---	Sharp
MEK peroxide	R,I,C	---	Cv 0.7	Cv 0.2	---	---	---	---	---
PCBs-42% Chlorine	R,A,I,C	Ca	1mg/m^{3}Sk	1mg/m^{3}Sk	---	---	---	---	Mild, hydrocarbon
PCBs-54% Chlorine	R,A,I,C	Ca	0.5mg/m^{3}Sk	0.5mg/m^{3}Sk	---	---	---	---	Mild, hydrocarbon
Styrene	R,I,C	5000	50	---	8.47	85	0.047	E 200-400	Rubber, solvent
Styrene monomer	R,I,C	---	---	50	---	---	200	---	Aromatic
Aluminum - metal dust	R,I,C	---	15mg/m^3	10mg/m^3	---	---	---	---	---
- soluble salts	R,I,C	---	2mg/m^3	2mg/m^3	---	---	---	---	---
Arsenic	R,A,I,C	Ca	0.01mg/m^3	0.2mg/m^3	---	---	---	---	---
Barium:soluble compounds	R,I,C	250mg/m^3	0.5mg/m^3	0.5mg/m^3	---	---	---	---	---
Berylium & compounds	R	Ca	0.002mg/m^3	0.002mg/m^3	---	---	---	---	---
Cadmium dusts	R,I	Ca	0.2mg/m^3	0.05mg/m^3	---	---	---	---	---
(Proposed value)				0.01mg/m^3	---	---	---	---	---
Chromium:									
Metal & insoluble salts	R,I	500mg/m^3	1mg/m^3	0.5mg/m^3	---	---	---	---	---
Soluble salts	I,C	250mg/m^3	0.5mg/m^3	0.05mg/m^3	---	---	---	---	---
Copper – dust & mist	R,I,C	---	1mg/m^3	1mg/m^3	---	---	---	---	---
Lead - arsenate	R,I,C	Ca	0.05mg/m^3	0.15mg/m^3	---	---	---	---	---
- inorg. dust & fume	R,I,C	---	0.05mg/m^3	0.15mg/m^3	---	---	---	---	---
- chromate	R,I,C	---	---	0.05mg/m^3	---	---	---	---	---
Manganese & compounds	R,I	10000mg/m^3	C-5mg/m^3	5mg/m^3	---	---	---	---	---
Mercury & inorg. Comp.	R,A,C	28mg/m^3	Cv0.1mg/m^3	0.1mg/m^3		---	---	---	---
- (organo) alkyl comp.	R,A,I,C	10mg/m^3	0.01mg/m^3	0.01mg/m^3	---	---	---	---	---
Nickel – metal, insoluble	R,I,C	Ca	1mg/m^3	1mg/m^3	---	---	---	---	---

Constituents of Concern (Circle)	Routes Of Exposure	IDLH (ppmV)	PEL (ppmV)	TLV (ppmV)	PID (eV)	FID (ppmV)	Odor Threshold	Irritation Threshold	Odor Description
- soluble comp.	R,I,C	Ca	0.1mg/m³	0.1mg/m³	---	---	---	---	---
Portland cement	R,I,C	---	10mg/m³	10mg/m³	---	---	---	---	---
Selenium compounds	R,A,I,C	100mg/m³	0.2mg/m³	0.2mg/m³	---	---	---	---	---
Silver – metal	R,I,C	---	0.01mg/m³	0.1mg/m³	---	---	---	---	---
- soluble comp.	R,I,C	---	---	0.01mg/m³	---	---	---	---	---
Thallium, soluble	R,A,I,C	20mg/m³	0.1mg/m³Sk	0.1mg/m³Sk	---	---	---	---	---
Tin, metal & inorganic comp. Except oxides	R,C	400mg/m³	2mg/m³	2mg/m³	---	---	---	---	---
Tin, organic compounds	R,A,I,C	200mg/m³	0.1mg/m³	0.1mg/m³Sk	---	---	---	---	---
Zinc chromates, as Cr	R,I,C	---	Cv0.1mg/m³	Cv0.1mg/m³	---	---	---	---	---
Zinc oxide dust	R,I,C	---	10mg/m³	10mg/m³	---	---	---	---	---

Notes: All units in ppm unless otherwise noted.

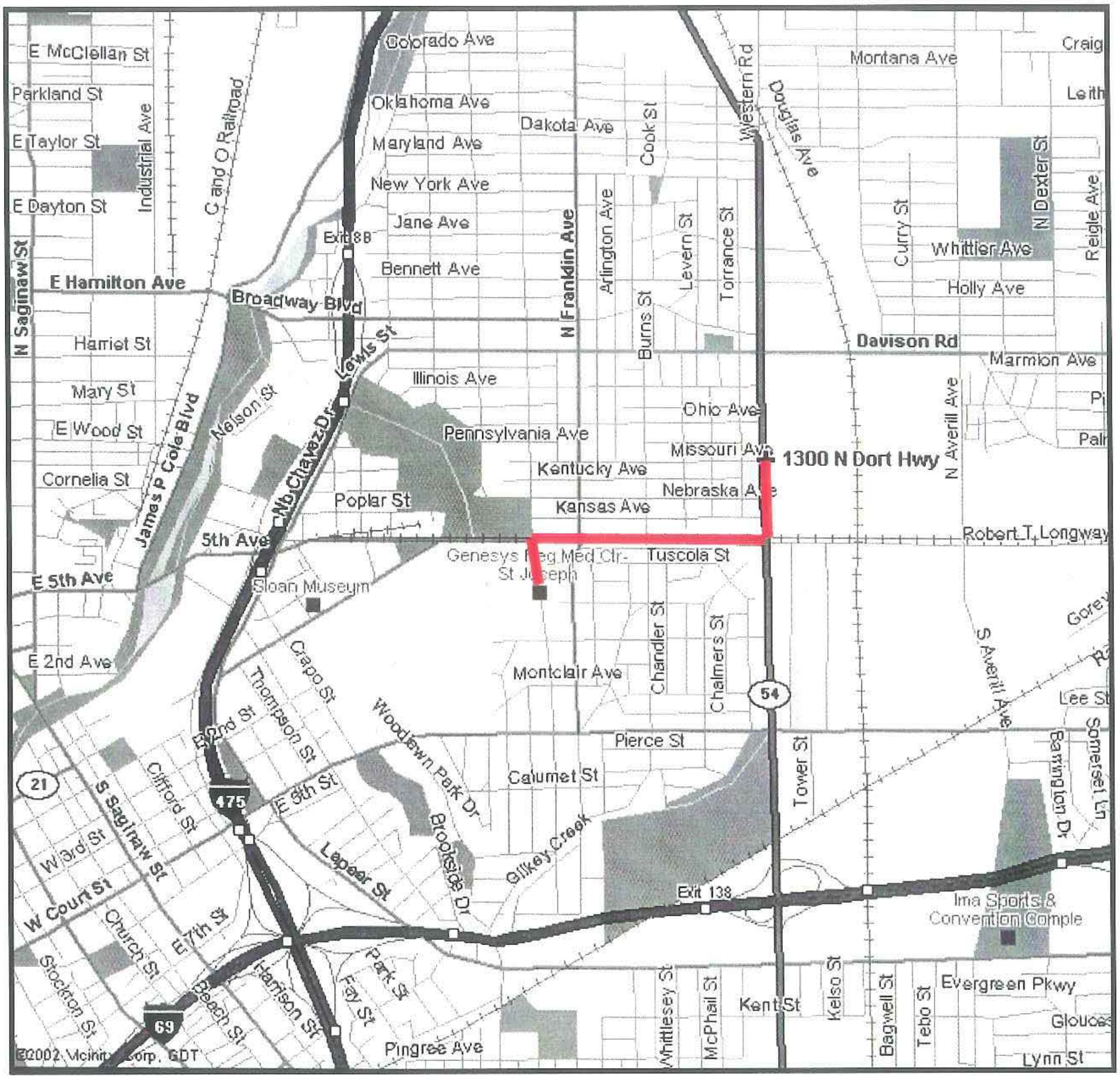
E = Eyes	R = Respiratory (Ihhalation)
N = Nose	A = Skin Absorption
T = Throat	I = Ingestion
SK = Skin	C = Skin and/r Eye Contact
Cv = Ceiling value	* = Use 10.2 eV lamp
Ca = Carcinogen	**= Use 11.7 eV lamp

TABLE 2

MONITORING METHOD, ACTION LEVELS AND PROTECTIVE MEASURES

INSTRUMENT	HAZARD	ACTION LEVEL[1]	ACTION RESPONSE[2]
Respirable Dust Monitor	Contaminant Particles		
OVA 128 (FID) and RAE (PID)[3]	Organic Vapors	Background 1 ppm above background (Vinyl Chloride OSHA permissible exposure limit); check Vinyl Chloride with Draeger 50 ppm > background; check TCE with Draeger 50 ppm >background 1000 ppm > background or VC >25 ppm or TCE>250 ppm	Level D Level C if VC >0.5 ppm Level C if TCE >50 ppm Level C if total organic vapor exceeds 50 ppm Evacuate. Need Level B or other controls.
Explosimeter[4]	Explosive Atmosphere	< 10% LEL Scale Reading 10-15% LEL Scale Reading > 15% LEL Scale Reading	Proceed with work Eliminate Hot Work. Continue Monitor with extreme caution Stop work. Evacuate work area.
O_2 Oxygen Meter[5]	Oxygen Deficient Atmosphere and Oxygen Enriched Atmosphere	19.5% O_2 19.5% - 23.5% O_2 < 19.5% O_2 > 23.5% O_2	Monitor with caution Continue with caution Evacuate site; oxygen Deficient atmosphere Evacuate site; fire hazard; oxygen enriched atmosphere
Hydrogen Sulfide Meter	Hydrogen Sulfide Gas	>5 ppm	Evacuate site; need controls; do not re-enter
Draeger Tube	Vapors/Gases	Species Dependent >0.5 ppm Vinyl Chloride (VC) >50 ppm Trichloroethene (TCE) >25 ppm VC or >250 ppm TCE	Consult manual for concentration/toxicity/detection data. Upgrade to Level C. Evacuate. Need Level B or other controls.
Carbon Monoxide (CO) Meter	Carbon Monoxide Gas	> 15 ppm	Evacuate site. Need controls. Do not re-enter

Notes:
1. MONITOR BREATHING ZONE
2. ALERT DELPHI SAFETY MANAGER BEFORE ANY SAFETY UPGRADE.
3. CAN ALSO BE USED TO MONITOR SOME INORGANIC SPECIES.
4. LOWER EXPLOSIVE LIMIT (LEL) SCALE IS 0-100%. LEL FOR MOST GASSES IS 15%.
5. NORMAL ATMOSPHERIC OXYGEN CONCENTRATION AT SEA LEVEL IS ~ 20%.



1300 N Dort Hwy
Genesys Reg Med Ctr-St Joseph
E McClellan St
Parkland St
E Taylor St
E Dayton St
E Hamilton Ave
Broadway Blvd
Harriet St
Mary St
E Wood St
Cornelia St
5th Ave
E 5th Ave
E 2nd Ave
Colorado Ave
Oklahoma Ave
Dakota Ave
Maryland Ave
New York Ave
Jane Ave
Bennett Ave
Exit 88
Lewis St
Illinois Ave
Pennsylvania Ave
Kentucky Ave
Kansas Ave
Poplar St
Sloan Museum
N Franklin Ave
Davison Rd
Ohio Ave
Missouri Ave
Nebraska Ave
Robert T Longway
Tuscola St
Montclair Ave
Pierce St
Calumet St
Gilkey Creek
Montana Ave
Whittier Ave
Holly Ave
Marmion Ave
Exit 138
Ima Sports & Convention Comple
Evergreen Pkwy
Kent St
Pingree Ave
Lynn St
475
69
54
21
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COMMUNITY RELATIONS PLAN

DELPHI CORPORATION
DELPHI ENERGY & CHASSIS SYSTEMS
PLANT 400
1300 NORTH DORT HIGHWAY

FLINT, MICHIGAN

U.S. EPA ID # MID 005 356 647

by

Haley & Aldrich, Inc.
Cleveland, Ohio

for

Delphi Corporation
Troy, Michigan

March 2003
File No. 49017-007

HALEY & ALDRICH

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I. INTRODUCTION

This Community Relations Plan (CRP) is submitted as an attachment to and forms part of RFI Work Plan submitted by Delphi Corporation for the Plant 400 Site.

The CRP is intended to identify the mechanisms for the dissemination of information to the public regarding investigation activities and results.

II. COMMUNITY RELATIONS PROGRAM ACTIVITIES

2.1 Community Relations Goals

The goal of the CRP is to prepare a plan for the dissemination of information to the public regarding investigation, activities, and results.

The goal of the CRP is to:

1. keep the public informed as the RFI progresses and as results are received, and
2. provide a mechanism for disseminating information on a routine, as well as a non-routine, basis in response to individual requests.

2.2 Additional Communications Provisions

Quarterly progress reports will be prepared in accordance with Section V of the RFI Work Plan. These progress reports will provide prompt and accurate information regarding the status of the project to the U.S. EPA and interested parties. Quarterly reports will be submitted according to Figure 8 of the RFI Work Plan.

2.3 CRP Implementation

2.3.1 Plan

Implementation of the CRP will ensure a regular flow of information/data/results from Delphi to the general public during the course of the RFI process. An Information Repository will be created at the Flint Public Library, Flint, Michigan, 48503.

2.3.2 RFI Work Plan

A copy of the RFI Work Plan will be placed in the Information Repository. A Fact Sheet describing the RFI will also be placed in the Information Repository at this time.

2.3.3 Investigation Report

Following completion of the RFI Work Plan, an EI and an RFI report will be prepared. A final EI report and RFI report will be placed in the Information Repository. A Fact Sheet describing EI and RFI findings and conclusions will also be placed in the Information Repository.

2.3.4 Unscheduled Communication

Delphi will, as necessary, respond to comments or concerns of individual members of the public in response to individual requests.

III. SUMMARY

Regular communication through written progress reports is appropriate for the rate at which progress will occur. The review provisions of the scheduled public communications will ensure that adequate opportunity for comment is provided to the public. A list of community relations activities that may be used for this RFI are summarized in Table 1.

TABLE 1

SUMMARY OF POTENTIAL COMMUNITY RELATIONS ACTIVITIES

Establish Information Repository

Objective: To provide the community with access to information about the Site.

Action: An information repository will be established at the local public library:
Flint Public Library
1026 E. Kearsley Street
Flint, Michigan 48503
Phone - 810-232-7111

Discussion: The repository will include all final and significant items such as the fact sheets, Current Conditions Report, RFI Work Plan, the Environmental Indicators Report and the RFI Report.

Designate a Point of Contact

Objective: To provide the public with an individual who can provide accurate information on the project.

Action: Proposed contacts include:

Mr. Marc Martens (Delphi-Public Relations)
Phone - 937-455-7483

Discussion: The contact people will coordinate and direct responses to inquiries. When necessary, technical personnel will assist in providing responses.

Prepare and Distribute Fact Sheets

Objective: To inform the public of investigative activities.

Action: Fact sheets will be used on an as-needed basis.

Discussion: Fact sheets can be an effective method of providing information to the public.

Prepare Press Releases

Objective: To release accurate information as needed.

Action: Press releases will be used on as-needed basis.

Discussion: Press releases would be sent to the appropriate local media.

Public Notices

Objective: To formally notify the public of the information repository.

Action: Public notices will appear in the local newspaper.

Conduct Briefings

Objective: To keep interested parties informed of the project status.

Action: Briefings will be conducted on an as-needed basis.

Discussion: Briefings will be accomplished through informal telephone updates.